Practical Restoration Handbook

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INTRODUCTION

The purpose of the Practical Restoration Handbook (PRH) is very simple. It is to stop everybody having to re-invent the wheel(barrow).

For 30 years Waterway Recovery Group (WRG) Ltd has existed to co-ordinate the efforts of volunteers in inland waterway restoration. WRG has always produced fact sheets on the practical aspects of waterway restoration and similarly the IWAs Restoration Committee (ResCom) produced Information Notes on the more technical aspects of waterway restoration. Production of these Fact Sheets and Notes proceeded slowly and was piecemeal because of the need to depend on the goodwill of the volunteers and availability of expert members to prepare them.

In order to put this work on an organised basis the IWA decided to submit an application for a grant from the Department of Environment, Transport and Regions. The plan was to commission authors and editorial assistance, using IWAs own resources for the overall management and administrative support. The aim would be to produce two handbooks on waterway restoration within a period of about three years.

The IWA was successful in obtaining a grant from DoETR and also in persuading some 29 waterway groups, see Annex 1, to participate in the project and to subscribe funds for the work. The two handbooks are the **Technical Restoration Handbook** (produced by ResCom) and this **Practical Restoration Handbook** (produced by WRG). The Association is most grateful to those organisations which have provided funds and to the authors and reviewers who have provided the content of the handbooks.

It is hoped this handbook will distil the accumulated wisdom of years and further enhance the efforts and reputation of volunteers working on inland waterways. Hopefully the Handbook will give an insight into legal requirements, best practice, good sense and helpful hints and tips – in that order. Wherever possible the texts have deliberately been kept from being over-prescriptive to allow the creative thinking and individual solutions that have been the trademark of canal restoration so far.

WRG was very careful in its selection of both subject and author to give the reader the most balanced view of the subjects it felt were most often encountered. Each of these chapters of the PRH has come through an extensive review period by peers, subscribing canal societies, the DoETR (often via outside bodies) with a handbook manager maintaining overall consistency between chapters. However it is important to realise that each chapter is the work of the author.

There will always be continually changing legislation which means that often rather than dealing with a subject in depth, the text will give "golden rules" and a reference to where to find the most up-to-date version of the legislation.

We make no apology for the fact that so much of the text concerns Health and Safety. WRG has always paid careful attention to Health and Safety and this has resulted in an excellent safety record. Waterway restoration sits across two industries – agricultural and construction – the two worst offenders in Health and Safety terms yet WRGs safety record is very good. The WRG Board feels that it is the continuing policy to make Health and Safety the priority that has lead to this good record.

We also make no apology for the fact that some points are made humourously. Canal Restoration was always meant to be fun and that is undoubtedly the reason that many of us become so involved. It also helps with the readability of the text.

Disclaimers

To the extent permitted by law, neither Waterway Recovery Group Ltd nor the Inland Waterways Association is liable for any loss, injury, damage, claim or expenses resulting from any use of such information. Every care has been taken in the compilation and checking of the information contained in this handbook. However, the IWA and WRG cannot accept any liability for the accuracy of the statements in the Handbook or omissions therefrom and readers are recommended to seek professional advice on specific proposals or problems.

The information provided by this Handbook is not guaranteed to be error free; if you feel that there are any errors or omissions then please send details using the form in Annex 2 clearly marked to: PRH Amendments, Inland Waterways Association, 3 Norfolk Court, Norfolk Road, Rickmansworth, WD3 1LT.

Throughout this Handbook the male gender has been used. Anyone who has experience of WRG will know that this is for example purposes only and the points apply equally to male and female.

Stop Press

As this Handbook went to press two documents were published that are especially relevant to the Handbook. It is intended to review these works and include them in future revisions of the PRH.

The first is published by HSE books and is called *Charity and Voluntary workers: a Guide to Health and Safety at Work*, HSG192, ISBN 0 7176 2424 2. This is a joint document between the HSE and the Charities Safety Group. The CSG represents around 150 charities and groups. The guidance is primarily focussed on safety in charity shops and other non-construction scenarios, however, many of the guidelines can be applied to canal restoration and it does cover construction sites and conservation work. An associated training video has been produced. Price £12 for the booklet and £25 for the video.

The second is a package produced by The Environment Agency and is called *Bank Protection*, it offers guidance and includes a CD-ROM. Price £95.

ANNEX 1 – WATERWAY GROUPS CONTRIBUTING TO THE RESTORATION HANDBOOKS PROJECT

Ashby Canal Association
Barnsley Canal Group
Birmingham Canal Navigations Society
Buckingham Canal Society
Caldon Canal Society
Chesterfield Canal Trust
Chichester Canal Society
Cotswold Canals Trust
Droitwich Canals Trust
East Anglian Waterways Association
Foxton Inclined Plane Trust
Herefordshire and Gloucestershire Canal Trust
Inland Waterways Protection Society
Kennet and Avon Canal Trust
Lapal Canal Trust
Lichfield and Hatherton Canals Restoration Trust
Lough Navigation Trust
Manchester Bolton and Bury Canal Society
Pocklington Canal Society
Ribble Link Trust
Sankey Canal Restoration Society
Severn Navigation Restoration Society
Shropshire Union Canal Society
Sleaford Navigation Trust
River Stour Trust
Surrey and Hants Canal Society
Swansea Canal Society
Wey and Arun Canal Trust
Wendover Arm Trust
Wilts and Berks Canal Amenity Group

ANNEX 2 – ERRORS, OMISSIONS AND CORRECTIONS TO THE PRACTICAL RESTORATION HANDBOOK

Every effort has been taken to ensure that the PRH is as up to date and as accurate as possible. However, situations, legislation and techniques change. If you believe there is something that is inaccurate or something has been omitted that should be included then please given details below. Forward this form onto PRH Handbook Manager, 3 Norfolk Court, Norfolk Road, RICKMANSWORTH, WD3 1LT.

Please state clearly the Chapter name, page numbers, paragraph reference, etc. and give as full a description of the problem as possible.

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Amendment authorised:
Published:

Health & Safety - Section 1
Site Aspects

by
Alan Jervis

Please note that, for convenience, the Practical Restoration Handbook "Health & Safety" chapter is split into 4 sections:

1. Site Aspects
2. Personal Safety and Insurance
3. Construction Design and Management Regulations
4. Control of Substances Hazardous to Health

Although these sections are primarily separate there are subjects which overlap and so all four sections must be considered as one chapter. It is essential that all four sections are read together to get an adequate understanding of the Health and Safety requirements for waterway restoration.

CONTENTS

This document is a completely revised version of the Waterway Recovery Group’s ‘Health and Safety Guide’. The author is grateful to the following people for their assistance with the original volume:

John Baylis, Dave Carnell, Christine Meusz, John Palmer and Mike Palmer.

INTRODUCTION

1. This guide is intended primarily for site leaders and others who have responsibility for the operation of waterway restoration work sites. This volume deals with the Health and Safety areas which should concern a leader in setting up and operating a site. It is not exhaustive and common sense will carry site leaders far. Leaders need not be expert in all of the techniques and in the operation of all plant on a site, but should be aware of the hazards and of the working practices required. The advice frequently given to volunteers: “If in doubt, don’t”, applies with even greater force to leaders. Leaders should not take responsibility for plant or construction techniques which are unfamiliar, but should recognise their limitations and ensure that there is a competent and experienced person on site who is familiar with the equipment or technique.

2. Health and Safety Legislation does not apply to volunteers working on sites where there are no paid employees. However, it has a great deal to say which is useful as guidance in the safe operation of a work site and, as such, we recommend that its requirements are studied and, where sensible, used as guidelines for the operation of voluntary sites.

3. If a restoration society has even one employee, and that employee works on site alongside volunteers, then the site must be registered and the full provisions of the Health and Safety at Work Act apply.

4. This guide outlines what we believe is a sensible approach to ensuring the safety of volunteers on a site and it written from the premise that the site is not registered and that there are no employees working there. It does not intend to set out working methods, but to serve as a guide to safe and healthy working practices. If positive steps are taken by all concerned, more efficient, productive and rewarding work parties will ensue. This guide does not absolve you from the need to take common sense precautions and its listing of safety procedures is not exhaustive.

5. Personal health and safety standards are only as good as you make them.

6. Later sections outline specific areas which should receive consideration and offer advice on them. Your attention is also drawn to the associated publications in this series which cover the Control of Substances Hazardous to Health (COSHH) and the Construction, Design and Maintenance (CDM) regulations.

GENERAL GUIDELINES

7. Most of the following points are amplified in later sections of this document.

8. Before agreeing to undertake work on a waterway site, restoration groups should give careful consideration to matters of volunteer health and safety. If, after this consideration, it is felt that the group cannot make proper arrangements for some aspect of volunteer health and safety, then advice and guidance should be sought from those more experienced and work on the site should not begin until all such matters have been satisfactorily resolved.

9. The organisation should have a formal health and safety policy which is available to all volunteers; a possible model is on a later page.

10. The organisation should have a small and easily-read volunteers' guide to health and safety which should be available at all times to volunteers. We recommend that all new volunteers are asked to sign a document which states that they have received a copy of this guide, have read it and agree to abide by its contents.

11. Site organisers should themselves be of sufficient experience and maturity to understand the health and safety issues likely to arise on their site and should have assessed them carefully before work begins.

12. Site organisers must be willing to bar from site any volunteer who disregards health and safety matters after a clear warning and must be of sufficient maturity to be willing and able to enforce this regime. Committees of groups and societies must be willing to give this backing to the site organiser without reservation.
13. It is essential that volunteers comply with Health and Safety requirements and you should be rigorous in your dealings with them. Minor transgressions should be given a stern warning; major transgressions or a second minor one should result in the volunteer being sent home. You owe this to other volunteers, your organisation and to the whole of the waterway restoration movement. The accident record so far is good; were it not, we would find it impossible to obtain insurance and that would effectively stop volunteer restoration work over the whole country. Finally, of course, you owe it to yourself: even if not legally liable, you will have to live with the consequences if you are lenient with volunteers who break the safety rules. It is one of the most difficult things a leader can be called upon to do; if you think that you could not do it, you should not be a site leader.

General Considerations : Checklist

- Under no circumstances should any volunteer work alone (out of sight or earshot of others).
- Every site should have adequate means of emergency communication. In these days, this could be a volunteer's personal mobile telephone - but site organisers should check that it will operate from all parts of the site; such equipment often has 'dead spots' which could be crucial in an emergency.
- Every site should have a first aid box which is adequate and regularly checked and should maintain an accident book. It is good practice to ensure that there is a trained first-aider on site at all times.
- All site personnel should know the location of the nearest hospital with a (functioning) Accident and Emergency Unit.
- All personnel working on a site should be properly trained for the tasks which they are asked to undertake, and particularly in the operation of any plant or equipment which they may use. Other volunteers should be made fully aware of the hazards of working on a site where plant and equipment operates. WRG operates a driver authorisation scheme, participation in which is mandatory for those groups using the IWA/WRG Insurance Scheme.
- All volunteers should be adequately insured against the risks they will encounter on site; such insurance should be arranged by the site organisers and may not be left to the individual. Note that groups using the IWA/WRG Insurance Scheme must also participate in the WRG driver authorisation scheme.
- If the site is accessible to the public, careful consideration should be given to the safety of members of the public whilst work is in progress and to fencing and otherwise making the site safe when work is not in progress.

- Do not expect a volunteer to perform an unfamiliar job without instruction.
- Take careful note of the capabilities of individual volunteers. Be particularly careful to ensure that tasks given are within the physical and mental capabilities of the volunteer. Many may be too embarrassed to admit a lack of knowledge, or that a particular task is beyond their strength.
- Do not allow volunteers to perform demanding tasks for long periods without rest; work which is within the capabilities of volunteers for a few minutes may prove impossible to sustain for longer periods.
- Always observe normal safety practices and if in doubt, seek advice.
- Keep your eyes and mind on the work in hand. It is the task of the leader to superintend the site. If you are the leader, do not allow yourself to become so wrapped up in one aspect of the work that you are unaware of the conduct of the remaining volunteers.
- Think the job out before you start and ensure that volunteers are given clear instructions both about the work and about health and safety matters.
- Encourage others by working safely and setting a good example, and look out for the safety of others.

A SPECIMEN HEALTH AND SAFETYPOLICY FOR A VOLUNTEER GROUP

Health and Safety Policy

14. It is the policy of (the Leafy Mould Canal Trust) when engaged on or associated with any restoration work or other projects connected with waterways to ensure that all reasonable and practicable safeguards are taken for the safety and welfare of all employees, volunteer workers, and visitors who are likely to be involved. This is not only for the benefit of such employees, volunteer workers and visitors but also to minimise pollution of the environment where possible.

15. Accident prevention has to have priority in all aspects of the (Trust's) work. The (committee) therefore ensures that so far as it possibly can, all conditions in which its members and any others are involved are both healthy and safe.

16. The (committee) makes the maximum effort to see that all supervisory staff and others in authority observe the (Trust's) policy in matters of health and safety working. The same is expected and required from its members, voluntary workers, and any person employed by it, at all times. To encourage this, the (committee) places great emphasis on the availability of both adequate and efficient safety equipment.

17. Whilst engaged in any project or associated with it in any way, members are urged in their own interests and that of their colleagues to observe health and safety standards and in no way to jeopardise the high standard required by the (Trust). Full co-operation and communication throughout the organisation, whether on site or otherwise, must therefore be maintained. Any matter which those participating in any activity consider may be a danger, to either health or safety, should be brought to the notice of their supervisors at the earliest opportunity.

(N.B. the items shown in italics should be replaced as appropriate)

GENERAL WORK HABITS - 'GOOD HOUSEKEEPING'

18. 'Good Housekeeping' covers all aspects of laying out a work site so that the work may be done efficiently and the safety of the volunteers is assured. The well known phrase "a place for everything and everything in its place" is one of the guiding principles of accident prevention. Sensible site organisation not only reduces accident risks by eliminating the physical hazards, but personnel can work more easily in clean and tidy surroundings than when disorder prevails. Too many accidents occur as a result of poor housekeeping. The work is also more efficient if proper consideration has been given to the establishment of materials stores, pipe and cable runs etc.

19. The overall layout of the site is the responsibility of the site leader and the most useful contribution individual volunteers can make to site safety is to practice good housekeeping within their own work area.

'Good Housekeeping' Checklist

- Never leave tools in a position where they can fall and injure someone. When they are no longer required, put them away tidily and in a clean and serviceable condition.
- Always tidy up after completing a job.
- If you see any material or equipment in a position that is likely to cause an accident, move it to a safe place. Broken glass, nails protruding from boards and badly stored equipment are common causes of injury.
- Keep roads, gangways and all other routes free from obstruction at all times.
- Encourage others to follow your efforts in good housekeeping.
- Materials must always be stored neatly and tidily and should never be over-stacked so that they become falling hazards.
- Materials must always be stored in compliance with the manufacturer's instructions and any relevant regulations.

SPECIFIC STORAGE AND HANDLING CONSIDERATIONS

Petrol and Two-stroke Mixture

20. Storage of flammable liquids, chief among which is petrol should be given careful attention. Only suitable containers should be used and should be clearly marked. This is particularly important where both petrol and two-stroke mixtures are kept on site. Petrol must be stored in suitable metal or plastic containers with screw caps and marked PETROLEUM SPIRIT - HIGHLY FLAMMABLE. Do not store petrol or two-stroke mixture in any improvised container. The maximum amount that may be stored in any one building is:-

In metal containers	2 x 2 gall (10 litre) cans
In BS approved plastic containers	1 x 5 litres

21. **DO NOT** store such containers under stairways or adjacent to emergency exits and doorways. Larger quantities, up to 60 gallons, should be kept in a specially constructed store at least 20 feet (6 metres) from any other building and suitably marked.

22. Equipment should not be refilled whilst it is running and care should be taken not to allow petrol (or its heavy vapour) near hot exhausts and naked flames.

LPG (Liquefied Petroleum Gas)

23. There is much legislation on the storage and handling of LPG. Some of the more relevant points are:

Carriage

24. The carriage of flammable gases in vehicles on public roads is subject to regulation. Included in the Carriage of Dangerous Substances in Packages Regulations are butane (blue cylinder) and propane (red cylinder) LP Gases, and gases used for welding and cutting purposes. When these gases are carried in containers of 5 litres or more the Regulations require:-

    a. The driver of the vehicles to be aware of the correct manner in which to carry the containers (cylinders) and the dangers that can arise from leaks, fires or other emergencies.

    b. Documentation must be carried, showing the substances carried. This must be made available to any Police Officer or Dept. of Transport Traffic Examiner on request.

    c. Vehicles carrying more than 500 kg of such substances must display warning orange-coloured plates to the front and rear.

25. There are exceptions to these Regulations which apply to items (b) and (c) above. These are under Regulation 3 (2): "The carriage of LPG cylinders which are part of equipment being carried in a vehicle such as tar boilers, burning gear, (cookers and fridges and boilers) are exempt. This exception permits the carriage of a single spare cylinder (per appliance) with such equipment as long as the equipment concerned operates using only a single cylinder."

26. Should the occasion arise when replacement of a cylinder is required from a stockist, and the cooker is not being carried, Reg. 3 (2) (j) 'excepts from the regulation the carriage of dangerous substances by the public for recreational and other purposes'.

The Storage and Use of LPG

27. Every year about half the accidents involving LPG in industry occur in the construction sector. Refillable LPG cylinders are used extensively on waterway sites and it is important to observe the following:-

    Storage:

28. When not in use, cylinders should preferably be stored outside in a well ventilated area at ground level on a firm surface and at least three metres away from any cellars, drains, excavations or other hollows where the denser-than-air vapour may collect. There should be good access to the area which should be kept clear of combustible material including wood, packing materials and vegetation.

29. If storage in the open air is not reasonably practicable, cylinders may be stored in adequately ventilated storerooms that are constructed of non-combustible materials.

30. It is important that all so-called empty cylinders' valves are kept closed and plugs, caps or shrouds are kept in place on ALL cylinders. All cylinders must be stored with the valves uppermost.

31. At the end of each working day precautions must be taken to ensure that gas supplies to all equipment are isolated and special care taken to ensure the cylinders are not tampered with or vandalised, e.g. removal to a secure store.

Ventilation:

32. It is essential to ensure there is adequate ventilation of the space in which the burners are being used. Incomplete combustion can lead to a build-up of carbon monoxide and this has led to many fatalities. Also the vapour is dense and if an appliance should leak, it can accumulate until and explosive mixture is formed.

Handling of LPG Cylinders:

33. Cylinders should always be handled with care. The valve on a cylinder should not be used for lifting or to lever the cylinder into position. Damage to the valve can lead to a highly dangerous leak. For the same reason cylinders should not be thrown or dropped. The 'neck' or valve is the most vulnerable point on the cylinder.

Connecting LPG Cylinders:

34. Before connecting any cylinder or container of LPG to equipment it is essential that all fires, flames or other sources of ignition including pilot lights and cigarettes in the vicinity are extinguished. If a cylinder is found to be leaking and cannot be stopped it should be carefully removed to a well-ventilated area free from sources of ignition. The area should be cordoned off with warning notices, and left until the leak ceases. The cylinder should then be marked and the supplier informed. Under no circumstances should users attempt to dismantle valves or repair the defect.

35. Note that if valves or regulators are attached to propane (red) cylinders by screw threads, they will be left-hand (i.e. will operate in the reverse of the normal manner). Small butane (blue) cylinders have conventional right-hand threads. Having connected the cylinder, the connection should be checked for leaks, by smell or soapy water, NOT by matches or naked flame. Use the correct size of spanner; do not use 'stilsons' or adjustable wrenches. Do not use oil, grease of PTFE tape when fitting regulators to cylinders.

Soap Testing:

36. This is the preferred way to trace gas leaks on propane (red cylinder), butane (blue cylinder) and compressed air systems. Very simply a small amount of soap or washing-up liquid is shaken into a foam with a small amount of water and then brushed or carefully poured over the suspect joints. Any leaks will cause the solution to bubble. If a leak is found, turn off the supply and remake the joint. Switch on and retest until satisfactory.

Regulators and Hoses

37. These should be suitable for the type of gas and compatible with the cylinder. Flexible hoses should comply with the British Standard BS3212 or BS5120.

Lighting the Appliance

38. Follow the manufacturer's recommended procedure. Before turning the supply on at the cylinder ensure all appliance valves are closed. In the event of a leak from an unsuccessful attempt to light up, or an open valve leaking gas, turn off the gas and leave it to disperse before trying again. Check that any flame failure devices which are fitted are working properly.

SUBSTANCES WHICH MAY CAUSE HARM TO HEALTH

39. Substances hazardous to health may occur in any form - solid, dust, liquid, vapour etc. Many common and unregarded substances which are found in the home can be hazardous in the quantities found on site e.g. paint, oils etc. and the hazards of substances such as brick dust, mortar plasticisers and waterproofers or glass wool may be unexpected. Basically, the classification covers any substance which has the potential to cause harmful effects to health, either by inhalation, ingestion or contact with the skin. Before storing, handling or using any such substance, make sure you are aware of the potential effects and the relevant safety precautions and that you have communicated them to the volunteers who will be working with the substances.

40. You attention is drawn to the companion volume in this series which gives greater detail on the legislation and hazard sheets for the most commonly encountered hazardous substances. Site leaders should have assessed the site for potential contacts with hazardous substances, know the storage and safety precautions for each of them and the first aid treatment for victims.

41. In general, where protective equipment is indicated, make sure that it is available, that it is in serviceable condition and, most importantly, that volunteers actually make use of it.

42. Damage to health from exposure to these substances may be permanent and it is your responsibility to know what protective equipment and precautions are required and to make sure that they are in place.

43. For further information please refer to Section 2 : Insurance, Safety and First Aid and the HSE Construction Summary Sheet - The Control of Substances Hazardous to Health Regulations 1988 (COSHH). (No. SS16)

Cement and Concrete

44. This is one of the commonest hazards on a site and so details are repeated below. Cement dust, both airborne and in contact with the skin, can present a serious health hazard, as can cement in wet mixes such as mortar or concrete. With sensitive skins, burning can take place very quickly and all users should be fully aware of the hazard and of the precautions necessary. A particular danger is trapping of dust or splashes, e.g. around the top of boots, where damage is accelerated by abrasion and rubbing.

45. When cement is mixed with water such as when making concrete or mortar, or when the cement becomes damp, a strongly alkaline solution is produced. If this comes into contact with the eyes or skin it may cause serious burns and ulceration. The eyes are particularly vulnerable and damage will increase with contact time.

46. Strong alkaline solutions in contact with the skin tend to damage the nerve endings first before damaging the skin; therefore chemical burns can develop without pain being felt at the time.

47. Cement mortar and concrete mixes may, until set, cause both irritant and allergic contact dermatitis:

    - irritant contact dermatitis is due to a combination of the wetness, alkalinity and abrasiveness of the constituent materials
    - allergic contact dermatitis is caused mainly by the sensitivity of an individual's skin to hexavalent chromium salts.

First Aid Measures for Cement and Concrete Burns

Eye Contact

48. Wash eyes immediately with plenty of clean water for at least 15 minutes and seek medical advice without delay.

Skin Contact

49. Wash the affected area thoroughly with soap and water before continuing. If irritation, pain or other skin trouble occurs, seek medical advice. Clothing contaminated by wet cement, concrete or mortar should be removed and washed thoroughly before use.

Ingestion

50. Do not induce vomiting. Wash out mouth with water and give patient plenty of water to drink.

Inhalation

51. If irritation occurs, move to fresh air. If nose or airways become inflamed seek medical advice.

Accidental Release Measures : Cleaning Up

52. Recover the spillage in a dry state if possible. Minimise generation of airborne dust. The product can be slurried by the addition of water but will subsequently set as a hard material. Keep children away from clean-up operation.

Storage and Handling

Storage

53. Bags should be stacked in a safe and stable manner.

Handling

54. When handling cement bags due regard should be paid to the risks. Some bags may have a small amount of cement on the outer surface. Appropriate personal protective clothing should therefore be used whilst handling.

Personal Protective Equipment

Respiratory Protection

55. Suitable respiratory protection should be worn.

Hand and Skin Protection

56. Protective clothing should be worn which ensures that cement, or any cement/water mixture e.g. concrete or mortar, does not come into contact with the skin. In some circumstances such as when laying concrete, waterproof trousers and wellingtons may be necessary. Particular care should be taken to ensure that wet concrete does not enter the boots and persons do not kneel on the wet concrete so as to bring the wet concrete into contact with unprotected skin. Should wet mortar or wet concrete get inside boots, gloves or other protective clothing then this protective clothing should be immediately removed and the skin thoroughly washed as well as the protective clothing/footwear.

Eye Protection

57. Dust-proof goggles should be worn wherever there is a risk of cement powder or any cement/water mixture entering the eye.

Short term effects

Eye Contact

58. Cement is a severe eye irritant. Mild exposures can cause soreness. Gross exposures or untreated mild exposures can lead to chemical burning and ulceration of the eye.

Skin

59. Cement powder or any cement/water mixture may cause irritant contact dermatitis, allergic (chromium) dermatitis, and/or burns.

Ingestion

60. The swallowing of small amounts of cement or any cement/water mixtures is unlikely to cause any significant reaction. Larger doses may result in irritation to the gastro-intestinal tract.

Inhalation

61. Cement powder may cause inflammation of mucous membranes.

Chronic effects

62. High repeated exposures have been linked with rhinitis and coughing. Skin exposure has been linked to allergic (chromium) dermatitis. Allergic dermatitis more commonly arises through contact with cement/water mixtures than dry cement.

PROTECTIVE CLOTHING AND EQUIPMENT

63. Personal Protective Equipment (PPE) must be used where there is a risk of harm due to contact with materials or substances or where plant or equipment which requires it (e.g. chain saws) is being used. Where personal protective equipment is required on a site, the leader should issue it and check that it is in good condition. It then becomes the volunteer's responsibility to maintain it in a usable condition and to report any damage or faults.

64. The following is a brief guide, but for detailed information please refer to the HSE publication YOUR BODY AT RISK : ARE YOU PROPERLY PROTECTED? (HSE Construction Sheets nos 28-35, ref. NIS/06/28-35)

Head Protection:

65. Safety helmets must be worn where there is a risk of head injury - only turban-wearing sikhs are exempt from this requirement. ('Bump caps' do not provide sufficient protection against impact and are not suitable for construction sites.) The helmet must be adjusted correctly to provide a good fit and if the task requires frequent bending, a chin strap should be used.

66. Safety helmets should not be worn back to front - safety comes before fashion!

67. Safety helmets manufactured to BS5240 have a useful life of approximately 5 years, which can be shortened by exposure to strong sunlight, repeated minor impact damage or the application of paint or labels. The date marking can usually be found on the underside of the peak. Helmets which are well out of date should be destroyed and replaced.

Eye/Face Protection:

68. Suitable eye protection should be worn to prevent harm from dust, flying particles, fumes, strong light and heat. Safety glasses, goggles or face shields are available and appropriate protection for the task should be selected. When carrying out work which could affect others, (e.g. welding, chipping or grinding) remember to provide appropriate screening to prevent harm.

Hand/Skin Protection:

69. Where gloves are required ensure that volunteers use them. Make sure to select the right gloves for the job. Some materials from which gloves are made can be irritant in themselves - this problem can usually be avoid by the use of cotton liners.

- Wash hands frequently, especially if the skin is contaminated by hazardous substances (e.g. cement).
- Do not use solvents or abrasives to clean the skin - these destroy the skin's natural protective oils and can lead to dermatitis - use only proprietary branded skin cleansers.
- Use of a moisturising 'after-wash' cream helps prevent damage. Barrier creams may be used if desired, but their effectiveness is limited and there is a danger of them sealing in the irritant; they are generally not recommended.

Protection of Feet:

70. Safety boots, shoes or wellingtons with steel toe caps and protected mid-sole are recommended, and should be in good repair. In the event of an injury to the foot, safety footwear should be removed as soon as possible as the foot may swell, which can cause further damage.

Hearing Protection:

71. Damage to hearing caused by exposure to high levels of noise is irreversible. The Noise at Work Regulations define the noise levels at which protective measures must be taken but as a rough guide - if you have to shout to be heard by someone standing close to you, you should both be wearing hearing protection.
72. Ear protection may take the form of ear muffs or ear plugs, whichever is appropriate for the individual and the task being carried out.

Respiratory Protection:

73. Some operations (e.g. using disc saws on concrete etc.) can produce high levels of dust and particles. Inhalation of some dusts and fumes can cause permanent damage to health and appropriate respiratory protection must be worn. Remember that this will usually need to be combined with eye/face protection and it is important that both can be worn without discomfort. Ensure that the correct grade of filter is fitted to any respirator or dust mask used and that the filter is serviceable.

74. Site leaders must ensure that only properly approved safety equipment is issued, that it is worn at all times when required, that it is in good condition and that it is not abused or treated lightly by volunteers.

SPECIFIC SITE HAZARDS

Work on Elevated Locations

75. Leaders should be sensitive to the problem that some volunteers will be afraid of heights and may not wish to work on ladders or scaffolding and that they may well feel embarrassed to admit this in front of others.

Ladders

76. When using ladders on site, you should ensure that they are in good condition and that volunteers understand the safe use of ladders.

Ladders Checklist

- Ladders must stand on a firm even base.
- Ladders must project at least one metre (3’ 3”) above any landing, or work area, or one metre (3’ 3”) above the highest rung to be used if working from the ladder.
- The pitch of the ladder should be approximately 4 to 1, i.e. for a ladder placed 6m (20’) up a vertical wall, the base should be 1.5m (5’) away from the base of the wall.

- Volunteers should always face the ladder when climbing and descending.
- Defective ladders must not be used - have them removed from the job until they are repaired or destroyed.
- Ladders should be secured in position near the top to prevent them slipping. If they cannot be secured at the top, they should be secured at the base using fixed blocks or cleats, sandbags, stakes embedded in the ground etc. Where it is not practicable to do this, a second person should 'foot' the ladder until the user has returned to the bottom. 'FOOTING' IS NOT CONSIDERED ACCEPTABLE FOR LADDERS LONGER THAN 5 METRES (16 feet)
- Ladders should be inspected regularly.
- Ladders should not be placed where they (or volunteers climbing them) may come into contact with unprotected live electrical equipment.
- Ensure that volunteers do NOT over reach from a ladder - make them move the ladder to a more convenient position.
- Ensure that volunteers keep their hands free when climbing ladders. Tools and equipment should be carried on the waist belt or lifted by hoist.
- Ensure that volunteers are aware of the hazards of slippery rungs and mud and worn shoe soles.
- Wooden ladders should not be painted

77. You will find HSE Construction Sheet No2 (rev) - Safe Use of Ladders (ref. NIS/06/02) useful.

Scaffolding:

78. Scaffolding on site should be left to competent personnel who understand the design of scaffolding structures.

Scaffolding Construction Checklist

- Do NOT erect 'makeshift' scaffolding.
- Scaffolding must be erected by, or under close supervision of, competent personnel and should be designed to meet the requirements of the job.
- Staging platforms should have guard rails and toe boards if persons or materials are liable to fall more than 2 metres (6'6") or if they could injure passers-by.
- Do NOT use tubes and clips that are bent or pitted with rust.
- Safe access to platforms must be provided by suitable lashed ladders, which should be removed when the scaffolding is left unattended.
- Scaffolding must also be dismantled by competent persons.
- Scaffolding must be inspected before it is used, and at regular intervals thereafter, and a record of inspections kept on site.
- Check for insecure foundations, placed on uneven ground.
- Check for insecure supports, such as drums, ladders and bricks.

79. Site leaders can carry out their own inspections of scaffolding. It should be checked at least once a day. The record should show the location of the scaffolding, the date, the condition and the signature of the person who carried out the inspection. Standard record books are obtainable for long term works.

Scaffolding Inspection Checklist

- Working platforms not wide enough - four planks is the minimum and five when used for storage of working materials.(although three is acceptable for light work (e.g. painting).
- Tightness of clips and clips fitted upside down.
- Ensure that no unauthorised modifications have been made to the structure.
- Absence of tie-ins and bracing where necessary.
- Boards inadequately fixed and liable to tilt or be blown off by the wind.
- Defective boards, having large knots or splits in them.
- Leaders should check frequently that volunteers are using scaffolding correctly and safely.

Scaffolding Accident Prevention Checklist

- Do NOT use incomplete or unsafe scaffolding.
- Place all loose materials not required for use so as to leave an unobstructed passage.
- Keep walkways free of slippery materials.
- Do NOT stack materials insecurely or so as to cause danger by over-loading.
- At the end of the period of work, leave the scaffold in a safe condition; lower suspended loads to the ground; do not leave materials aloft unless they will be needed within a short time.
- Materials and tools must be lowered from elevated locations and not dropped.
- A means of preventing materials from falling must be incorporated in the construction of the platform and scaffolding, e.g. toe boards.
- Where there is a risk of falling objects, the area below must be roped off to prevent personnel from entering.

80. The most complete set of requirements for scaffolding erection and use is contained in the ‘Construction (Working Places) Regulations (1966)’

81. See also HSE Construction Sheet No 3 (revised) - General Access Scaffolds (ref. NIS/06/03)

Excavations

General:

82. Planning and design of excavations is a specialised area which must only be undertaken by competent and experienced personnel and appropriate shoring must be provided. Installation of support work must be carried out by experienced workers under the supervision of a competent person and it must be soundly constructed. All struts and braces must be secured so that they cannot be accidentally displaced.

83. Excavations must be regularly inspected by a competent person and those inspections recorded. See notes on scaffolding records.

84. Safe access into and out of excavations must be provided and adequate means of escape must be available, particularly where there is a danger of flooding.

Excavations Checklist

- Erect adequate barriers / fencing to prevent people falling into the excavation.
- Ensure that spoil is thrown clear of the sides of the excavation.
- Maintain shoring.
- Provide safe means of access / egress and ensure that they are used.
- Take precautions to avoid vehicles being driven into the excavation e.g. provision of stop blocks and ensuring only trained and experienced operators use vehicles and plant in the vicinity.
- Inspect shoring daily when work is in progress, and whenever there is a change in climatic conditions (see below).
- Ensure adequate ventilation (see below).

85. **Do Not:**

- Allow anyone to work in an excavation if there is the slightest doubt about its stability.
- Keep vehicles, plant or equipment close to the edge - this could cause the side to collapse owing to overloading and fumes or vapour to collect in the excavations.

Inspection:

86. Excavations should be regularly checked by a competent person and a record kept of the inspections. See notes under inspection of scaffolding.

Excavation Inspection Checklist

- Movement of soil due to drying out, absorption of water or freezing.
- Shrinkage of timber shoring (through drying).
- Runs or leakage of soil from behind sheeting.
- Wedges must be checked and tightened as necessary.

Ventilation of Excavations:

87. Ventilation in trenches can be poor. Positive steps must be taken to prevent exhaust gases, petrol vapour or LPG collecting in the bottom of trenches and to provide adequate fresh air. Remember that a lock chamber, a tunnel or a bridge hole in calm weather will have the same ventilation needs and difficulties as an excavation.

Stop Planks, Stanks and Earth Dams:

88. These fall into the same category as excavation shoring and must be checked prior to each day's work and whenever there is a change in climatic conditions. More frequent checks should be made when they are holding water at a level above that at which volunteers are working.

89. REMEMBER : Adequate means of escape must be provided in case of emergency. Consideration must be given to the number of people working in the area who will need to escape quickly should water break through the barrier, and to the force with which this may occur.

90. See also HSE Construction Summary Sheet - Safety in Excavations. (ref: SS8 revised)

SPECIFIC SITE PLANT

Mechanical Plant

91. Mechanical plant must only be driven or used by competent persons. If your organisation participates in the IWA/WRG insurance scheme, it is essential that operators hold a WRG Insurance Authorisation Card for the relevant plant category and that the permission of the Site leader has been obtained. The site leader must be satisfied that drivers / operators are aware of the correct method of operating the plant; particularly with tractors, dumpers, and other earth-moving equipment. All dumper drivers must hold a full, current driving licence or an exemption issued by the WRG Board.

92. Plant should be checked daily by a competent person; more often if the site conditions are particularly severe or problems are reported. The most important points to look at are:- tyres or tracks, steering, brakes (where applicable), cracks and leaks on the hydraulic hoses and fittings, oil levels and leaks.

93. It is a legal requirement that all plant and machinery is kept and maintained in an efficient state, and in good working order and in a good state of repair. Any defects must be reported to the site leader.

Mechanical Plant Operation Checklist

- When plant is being operated in a confined space or the operator's view is restricted he must have someone to guide him.
- NEVER reach under the raised body of a tipper lorry or dumper.
- NEVER use plant or equipment for work it has not been designed to do.
- ENSURE that warning notices "KEEP CLEAR" are fitted to the rear of cranes and earth-moving equipment that pivot round during operation.
- NEVER leave the engine of a dumper running whilst loading or unloading, unless the driver is at the controls.
- NEVER carry passengers unless there is a proper seat provided.

Hand Tools

94. Hand tools are often neglected as a source of hazard. They should always be kept clean, be well maintained and volunteers should be encouraged to use the proper tool for the job and to report defects at once. Remember that the use of hand tools may not be obvious; training should be given. For example, proper use of a shovel will make a volunteer more productive, less tired and less susceptible to back injury and it can not be assumed that everyone knows how to use such a 'simple' tool.

Hand Tools Checklist

- Always use the correct tool for the job.
- DO NOT use damaged or worn tools.
- NEVER use a file without a handle.
- Always use correct sized spanners.
- When using a sharp tool, keep your hands behind the cutting edge.
- DO NOT keep sharp tools in your pocket.
- Keep all tools clean and in good condition. Sharp tools when not in use should have their cutting edges covered.
- When using hand tools, if at all possible, wear protective gloves.

Lifting and Winching Tackle

95. Lifting equipment and hand winches such as Tirfors should be used with great care. Large forces can be generated with relatively small effort on the part of the volunteer. Tensions in ropes and cables can be very great and dangerous if suddenly released by a sling slipping or a cable snapping.

96. Lifting and winching operations should always be carried out by the minimum number of people, with all other volunteers safely out of reach. Volunteers carrying out lifting and winching should be experienced and full training should be given. Powered lifting and winching equipment is covered by the WRG authorisation scheme.

97. Lifting and winching equipment should be inspected before and during use by the team leader or the operator. Any signs of weakness, fraying, splitting or serious kinking should cause the rope or cable to be taken out of service at once. All such equipment is subject to regular inspection and certification. If your group participates in the IWA/WRG Insurance Scheme, such official inspections can be arranged through the scheme. All lifting equipment, e.g. chain sling, rope sling, or similar gear and a ring, link, hook, shackle, swivel or eye bolt, chain, rope or item of lifting gear, block and tackle, etc., MAY NOT be used unless it has been examined by a competent person and the regulation test certificates signed.

98. Lifting tackle (chains, slings, hooks, swivels etc.) should be examined every six months.

99. Lifting machines (cranes, winches, pulley blocks, barrow hoists etc.) should be examined every fourteen months.

100. A barrow hoist, sling, shackle, lifting chain or swivel must be marked with its safe working load. In practice it would be cheaper to hire such equipment for use on isolated occasions.

101. If equipment is hired - check with the hirer that the statutory examinations have been carried out!

Workshop Machinery

102. Workshop machinery is not often found on waterway restoration sites, except those long established schemes which usually have employees. If volunteers are using workshop equipment, leaders should ensure that they have the training and skills necessary to do so safely.

Workshop Equipment Checklist

- Do NOT operate any workshop machine unless you are fully trained and conversant with it.
- Ensure that the work piece is properly secured.
- Guards MUST be in position before the machine is started.
- Protective clothing and eye protection MUST be worn.
- Rotating parts MUST NOT be touched.
- Properly fitted clothing MUST be worn.
- Long hair MUST be covered.
- Report all faults immediately.
- Machinery should be switched off when not in use.
- Keep the machine and surroundings clean and tidy.

Cartridge Operated Tools

103. In general, volunteers should not use cartridge operated tools; the use of such tools is only permitted by experienced persons. They will only rarely be encountered e.g. when making fixings to concrete and are best left to professionals. Only the exact number of cartridges required will be carried by the operative concerned. The holder of the box of cartridges must be a responsible person and be able to account for each cartridge used. The stock of unissued cartridges must be kept in a locked container, away from heat or sources of ignition.

104. Warning notices should be posted in the areas where the work is being carried out. These areas should, as far as is possible, be kept clear of all other personnel.

Portable Power Tools

105. Portable power tools are a source of hazard to the operators, who must be fully trained and to others on site who are at risk from trailing pipes and cables etc.

Power Tools Checklist

- Always ensure that air-operated and electrical portable power tools are in good condition.
- If the tool is electrical, ensure the power cable is in good condition. If pneumatic, ensure the correct hose and fittings are used and in good condition.
- Ensure you have an adequate length of hose/cable, for the job - DO NOT TRY TO STRETCH IT.
- Keep cables and hoses away from water, oil, heat and sharp edges.
- Ensure cables, and especially connections, are supported.
- Do NOT lift or drag power tools by the air hose or cable.
- Take special care not to drop portable grinding tools as the wheel could be damaged and break when in use.
- NEVER force a grinding machine against the work, as dangerous flat spots could develop on the wheel.
- Grinding wheels may only be fitted by competent persons.

Use of Compressors and Compressed Air

106. Compressed air, like all substances under pressure, can be dangerous. The pressure accumulators of compressors are subject to official testing and inspection. If your group participates in the IWA/WRG insurance scheme, such inspections can be arranged through the scheme. Thought should be given to the siting of compressors, both from the point of view of minimising noise on site and for residents, and of minimising pipe runs. Modern well-silenced compressors are preferred and air hammers should also be equipped with silencers. Eye and hearing protection should be worn by operators and others in the vicinity. Length of work periods should be carefully monitored; the vibration of compressed air tools can be damaging to the circulation in the hands and they are some of the more physically demanding pieces of equipment found on work sites. Leaders should be particularly careful about the choice of volunteers assigned to the use of full-size road breakers (‘pneumatic drills’).

107. The maintenance demands of compressors are high; they should be checked several times a day.

Compressed Air Checklist

- NEVER use compressed air to clean up dust, filings, or swarf.
- NEVER dust yourself down with compressed air, as this can lead to serious injury.
- NEVER indulge in “horseplay” with compressed air.
- Check pipes and connectors regularly.
- Check the condition of air tools regularly.
- Check the compressor oil levels regularly.
- Ensure that volunteers using the equipment are physically strong enough.

- Ensure that appropriate eye and hearing protection are worn.
- Ensure that operators have regular rest periods.

Use of Generators and Electricity on Site

108. Generators offer a good opportunity to reduce noise levels on site; one generator placed at a distance and well silenced (use straw bales if necessary, but beware of potential fire hazard from sparks and hot exhausts) can power a number of items and save several engines running. Take care with siting cable runs and ensure that all cables and connectors are suitable. If 240V supply is used, a Residual Current Device of 30mA rating must be fitted, but you are strongly recommended to avoid 240V supply. If a mains supply is used, a 'step down' transformer should be sited next to the supply outlet and all site wiring should be 110V. If 240V equipment must be used, site wiring should be 110V with a 'step up' transformer located as close as possible to the equipment to minimise the length of 240V cabling. Remember that 110V is much safer than 240V, but can never be completely safe and so equipment, cables and connectors must be checked regularly.

Electrical Equipment:

109. Only authorised experienced personnel are allowed to service and maintain electrical equipment. Before any work commences on electrically operated/driven equipment, it must be isolated from the electrical supply. ALWAYS assume that all electrical equipment is LIVE until physically checked.

110. Volunteers should report all damaged equipment immediately and MUST NOT use it.

Electrical Equipment Operation Checklist

- NEVER improvise a junction box, or jam wires into a socket with matchsticks or nails.
- NEVER run power tools from lamp sockets so that they are not be earthed.
- NEVER force a plug into a socket.
- NEVER hang cables on nails or leave them lying about where they can get damaged or wet.
- NEVER use equipment with the earth pulled out.
- NEVER use wrong size fuses.
- NEVER misuse an earthing clamp on electric welding sets.

111. See also HSE Construction Summary Sheet - Portable Electric Tools and Equipment

Gas and Electric Cutting and Welding

112. These operations are infrequently met with on restoration sites. If they are carried out, particular care must be taken as they are potentially very dangerous. Only experienced operators should be permitted to use this equipment.

Electric Cutting & Welding:

113. Arc welding is a safe operation when carried out under correct conditions and using appropriate equipment. Welding “eye flash” is a very painful condition caused by looking at welding arcs without suitable eye protection. Welding operations must be screened from other workers and the public.

Arc Welding and Cutting Checklist

- All the cables and connections are sound and of adequate capacity.
- The earth cable is firmly secured to the item being welded.
- The welding area is dry, secure and free from obstruction.
- Adequate hand and eye protection is in use.
- Provision is made to accommodate the electrode holder when not in use. Laying a live holder on the face screen or a pair of gloves is not recommended.
- DO NOT suspend the welding cable. A fully insulated holder or hook MUST be used.
- DO NOT drag the cables across hot plates or welds.

Gas Cutting & Welding:

114. Gas cutting and welding are more dangerous than electric welding. Operators should be trained and experienced. Gas cutting should be regarded as a last resort and should only be undertaken by experienced operators working under close supervision. It is cutting operations on materials of unknown composition which are likely to give rise to toxic fumes. It is particularly important that operators wear approved eye protection and that other volunteers on site are instructed not to look at the flame head during the operation.

115. In common with other welding and cutting processes, gas cutting and welding is safe if proper precautions are taken. Take particular care with the storage of gas cylinders and check the condition and serviceability of regulators and hoses.

Explosion Hazard Checklist

- Acetylene (ethyne) forms an explosive mixture with air in any proportion between 2% and 82%. Therefore, make sure the work area is well ventilated and the equipment is leak free.
- Acetylene cylinders may explode due to excess pressure even in the absence of air. DO NOT store or stand acetylene bottles in locations where they can absorb heat and over-pressure.
- Acetylene cylinders must only be used in the upright position. When in use the valve key MUST always be left in position.
- It is possible when a nozzle tip is partially plugged (with metal slag) for oxygen to feed back and carry ignition into the acetylene pipe and cylinder. KEEP the nozzle tip clear.
- Oxygen concentration in a confined space may increase due to unburnt cutting oxygen. If oxygen/gas burning is done in a confined space, adequate ventilation must be ensured throughout the operation.

- Flash back arresters must be fitted on both gas lines.
- For most cutting operations, propane is a safer and more readily available alternative to acetylene.

General Welding Safety

Burns:

116. Burns are almost invariably caused through lack of care, or through failing to wear proper protective clothing. The welder must wear oil-free protective clothing. It MUST be remembered that skin can be burnt by emissions from the arc as well as by contact with hot metal. Articles which have been welded will be very hot on completion and should be set aside or marked to avoid injury to others who may handle them. Skin burns should be treated immediately by cooling in clean cold water for at least 10 minutes.

Eye Injuries:

117. Radiation from a gas or electric welding operation can be sufficient to cause considerable discomfort to the eyes. Standard welding eye protection MUST be worn and precautions taken to protect others ins the vicinity from this and from flying slag by the use of protective screens.

Fume Risk:

118. Good ventilation MUST always be provided for gas welding. The fumes and cutting of parts that are galvanised, lead-coated or otherwise treated, may be injurious to the operator and extra precautions involving special ventilation or the use of breathing apparatus in confined spaces will be necessary.

Welding Screens:

119. Screens must be adequate in size and must be painted with a non-reflective or matt finish.

120. See also HSE Construction Summary Sheet - Flame Cutting and Welding with Compressed Gases. (ref: SS12)

Rotary Mowers and Strimmers

121. The site versions of this equipment are generally more powerful and more dangerous than the domestic equivalent. Leaders should ensure that all operators are properly trained; experience on the domestic equipment is unlikely to be adequate. When using this type of equipment volunteers should always wear substantial footwear, preferably with steel toecaps and leg protection, (i.e. trousers or jeans, to protect against flying sap, stones and other projectiles) and eye protection (preferably a full mesh face visor) and ear protection.

Safety Checklist

- ALWAYS remove the plug lead before cleaning under the machine or attempting to remove the blades or line.

- REMEMBER the cutting blades or line continue to turn after the motor has stopped.
- Erect signs warning the public of the hazards.
- Keep the public and others out of range of flying debris (at least 10 metres away).

Chain Saws

122. Generally, the use of chain saws on site is not recommended. If they are to be used, site leaders should ensure that operators are experienced and properly qualified and that all other personnel are kept at a distance greater than twice the height of the tree being felled. Many accidents are caused by chain saws, in particular to left-handed people, as the saws are designed for right-handed users.

123. Most accidents are serious and are caused by “kick-back”, i.e. the tip of the blade touching the ground or other object and being thrown upwards. Only saws fitted with anti “kick-back” guards and “dead-hand” throttles should be permitted on sites.

124. The operator must always wear a full set of protective equipment. The minimum required protection is known as an “occasional user kit”. It consists of:-

- Helmet with face shield and ear defenders
- Padded gloves
- Padded over trousers
- Padded spats.
- Boots with steel toecaps (or approved ‘chain saw boots’) must also be worn.

125. The padding should be ‘KEVLAR’ or similar mesh which is designed to tangle and stop the blades before they have cut far into flesh.

126. Chain saws should only be used by competent and experienced operators who are fully aware of the safety precautions and routine on-site maintenance required.

Disc Saws and Grinders

127. Disc saws are tools with an abrasive cutting disc, usually powered by a small petrol engine, for cutting stone, concrete and steel. Disc grinders are usually electric and can be fitted with cutting discs; these are generally used for steel fabrication and cutting. Operators must be trained and must wear hearing and eye protection. For some jobs, respiratory protection and foot protection may also be required.

Disc Saw Checklist

- Saws should only be used by experienced personnel who have been trained in their use and in the changing of discs.
- Make sure that the correct disc is fitted for the job; stone and steel discs have different properties.
- Goggles are mandatory for the user; a full face visor is preferable.
- When cutting stone, concrete or brick, a dust mask MUST be worn.

- Keep other workers and the public out of range of flying debris and dust.
- Take special care not to drop portable grinding tools as the wheel could be damaged and break when in use.
- NEVER force a grinding machine against the work, as dangerous flat spots could develop on the wheel.
- Grinding wheels may only be fitted by competent persons.

APPENDIX 1 - LIST OF TEXTS AND PUBLICATIONS REFERENCE IN PRH "HEALTH & SAFETY SECTIONS 1-4"

Note that texts are listed under the section of the guide in which they are primarily referenced but may also be referred to in other sections. It is recommended that these texts are obtained as they will assist greatly with Health and Safety planning.

Section 1 - Site Aspects

Code	Title	Available from
	HSE Construction Summary Sheets	
SS2(rev)	Safe Use of Ladders	HSE
SS3 (rev)	General Access Scaffolds	HSE
SS6	Portable Electric Tools and Equipment	HSE
SS8 (rev)	Safety in Excavations	HSE
SS11(rev)	Safe Use of Propane and other LPG cylinders	HSE
SS12	Flame Cutting and Welding with Compressed Gases	HSE
SS16	The Control of Substances Hazardous to Health	HSE
SS17	Construction site Health and Safety Checklist	HSE
SS26	Cement	HSE
SS28-35	Your Body at Risk: Are you Properly Protected?	HSE
SS50	Personal Protective Equipment: Safety Helmets	HSE
na	Noise in Construction	HSE
na	Construction (Working Places) Regulations 1966	HMSO
na	Carriage of Dangerous Substances in Packages Regulation	HMSO
na	Health and Safety at Work Act	HMSO

Section 2 - Personal Safety and Insurance

Code	Title	Available from
green book	Volunteers' Health and Safety Guide	WRG
B1510	Accident Record Book	HSE
IND(G) 84L	Leptospirosis - are you at risk?	HSE
SS18	Provision of Welfare at Transient Construction Sites	HSE
SS46	Provision of Welfare at Transient Construction Sites	HSE
SS51	Construction Fire Safety	HSE
na	Insurance Briefing notes (various)	IWA

Section 3 - Construction Design and Management Regulations

Code	Title	Available from
na	Construction, Design and Management Regulations 1994	HMSO
F10	Notification of project to HSE	HSE
C400	CDM Regulations - How the Regulations affect you!	HSE
SS17	Construction Site Health and Safety Checklist	HSE
SS40	The Role of the Planning Supervisor	HSE

SS44	The Health and Safety File	HSE
	Guide to the Provision and Use of Work Equipment Regulations 1998	HMSO
	Guide to the Lifting Operations and Lifting Equipment Regulations 1998	HSE
F91/CE	Lifting Appliances Record	HMSO
F91/A	Scaffolding Record	HMSO
F91/J	Lifting Gear Record	HMSO
F91/B	Dam Inspection Record	HMSO
F2202	Welfare Arrangements Record	HMSO
na	Volunteers Working Safely	BW

Section 4 - Control of Substances Hazardous to Health

Code	Title	Available from
	Legal Acts	
na	Control of Substances Hazardous to Health 1998 & 1994	HMSO
na	Health and Safety at Work Act, 1974, 1992	HMSO
na	Factories Act 1961 Revised	HMSO
na	Health and Safety Information, Employees Regulations 1989	HMSO
na	Highly Flammable Liquids and Liquified Petroleum Gases Regulations 1972	HMSO
na	Approved Code of Practice Control of Substances Hazardous to Health 1994 (ACOPS)	HMSO
	Health and Safety Executive Guidance Notes	
	Environmental Hygiene Series:	
EH17	Petroleum based adhesives in Building Operations	HSE
EH8	Arsenic: toxic hazards and precautions	HSE
EH9	Spraying of highly flammable liquids	HSE
EH16	Isocyanates: toxic hazards and precautions	HSE
EH22	Ventilation of Buildings	HSE
EH26	Occupational Skin Diseases: Health and Safety Precautions	HSE
EH40	Occupational Exposure Limits (Revised Annually)	HSE
EH42	Monitoring Strategies for Toxic Substances	HSE
EH43	Carbon Monoxide	HSE
EH44	Dust in the Workplace: general principles of protection	HSE
EH46	Exposure to Mineral Wools	HSE
	General Series	
GS5	Entry into Confined Spaces	HSE
GS29/4/	Health and Safety in Demolition Work. Part 4	HSE
GS46	In Situ Timber Treatment using Timber Preservatives; health and environmental precautions	
	Medical Series	
MS8	Isocayanates; medical surveillance	HSE
MS15	Welding	HSE

	Hazard Information Sheets	
No. 1	Cements 1985	HSE
No. 5	Solvents 1988	HSE
No. 7	Skin Hazards 1988	HSE
No. 8	Pesticides 1989	HSE
	Construction Summary Sheets	
SS15	Confined Spaces 1988	HSE
SS24	Chemical Cleaners	HSE
SS26	Cement	HSE
SS27	Solvents	HSE
SS36	Silica	HSE
	Respiratory Protective Equipment	
BS4275	Recommendations for the selection, use and maintenance of Respiratory Protective Equipment 1974	HSE
	Respiratory Protective Equipment (RPE): Legislative Requirements and lists of HSE approved standards and type approved equipment 1989	HSE
	Health Safety Leaflets	
	Introducing COSHH. A brief guide for all employers to the the requirements for controlling hazardous substances in the workplace	
	Introducing Assessment: a simplified guide for employers	
	Managing Health and Safety in Construction	
	Part 1: Principals and Applications to main contractor/ visiting group projects. HMSO 1988	
	Part 2: Management Contracting HMSO 1988	
	Hazard and Risks Explained	
	Control of Hardwood Dusts 1987	
	Health Hazards to Painters 1989	
	Miscellaneous Documents	
	A Guide to Safe Use of Chemicals in Construction	CIRIA
	Construction Safety Manual : Section 25	BEC/BAS
	Development of Contaminated Land; Dept. Of Environment Circular 21/87	DoETR
	COSHH In Construction : A BEC Guide	BEC
L101	Safe Work in Confined Spaces	HSE

Addresses

Health and Safety Executive
HSE Books
PO Box 1999
Sudbury
Suffolk
CO10 6FS

HMSO
Any Local HMSO bookshop

Ciria
6 Storeys Gate
Westminster
London,
SW1P 3AU
0171 222 8891
www.ciria.org.uk

BEC Publications
Federation House
2309 Coventry Road
Sheldon
Birmingham
B26 3PL
0121 742 0824

Inland Waterways Association
Waterway Recovery Group Ltd
PO Box 114
Rickmansworth
WD3 1LT
01923 711114

Practical Restoration Handbook

Health & Safety - Section 2
Personal Safety and Insurance

by

Alan Jervis and Mike Palmer

Please note that, for convenience, the Practical Restoration Handbook "Health & Safety" chapter is split into 4 sections:

1. Site Aspects
2. Personal Safety and Insurance
3. Construction Design and Management Regulations
4. Control of Substances Hazardous to Health

Although these sections are primarily separate there are subjects which overlap and so all four sections must be considered as one chapter. It is essential that all four sections are read together to get an adequate understanding of the Health and Safety requirements for waterway restoration.

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Appendix 1 – List of Texts and Publications Reference in PRH "Health & Safety Sections 1-4"

Appendix 2 – Organisations participating in IWA/WRG insurance scheme

Appendix 3 – Volunteer registration form

Appendix 4 – Accident reporting procedure and contact details for insurance

Appendix 5 – A specimen safety talk for volunteers

Appendix 6 – Leptospirosis Data sheet

1. INTRODUCTION

1.1 Volunteers have achieved a great deal in canal restoration and they have saved many miles of canal through a unique mix of determination, skills, enthusiasm and sheer hard work. Unfortunately they are often perceived by external bodies as an increased risk on site as their experience of construction sites may be limited. However, it is precisely because they know nothing about construction sites that, with simple precautions and proper briefing, they can be much more cautious and thus safer. This chapter outlines precautions to be taken on site and offers guidance for briefing of volunteers.

1.2 Although volunteers are low cost, this does not mean they are free, history shows us that it is unwise to class them as 'unskilled cannon fodder' and training and investment pays dividends. This is especially the case for Health and Safety. A responsible attitude and a little time and effort paid to Health and Safety results in a good working environment that volunteers are keen to return to time after time. The volunteer has only one objective: to finish the job properly – and (s)he can't do this from hospital!

1.3 As a further practical point although volunteers are a "cheap" resource they can sue you if injury results from your failing to take your Health and Safety responsibilities seriously. This can prove very expensive (and an injured member of the public would be even costlier!).

1.4 Please note that, because each restoration project is different, what are given here as guidelines of good practice may well become essential practices for your site, particularly if your site complies with requirements under Construction Design and Management Regulations (see PRH "Health and Safety Section 3"). It is the authors opinion that, even where it is not mandatory, it is "best practice" to adopt a structure that at least follows the spirit of CDM i.e. both responsibilities and information concerning Health and Safety are clearly outlined and communicated.

1.5 This guide is based on current practice of the Waterway Recovery Group (WRG – the national co-ordinating body for voluntary labour on the inland waterways of Britain but is written with all waterway restoration societies in mind. Thus some recommendations contained within this guide will be noted as mandatory for WRG groups who have adopted them as best practice for all their activities. This does not necessarily mean they are mandatory or legally required for your project.

2. VOLUNTEERS - EDUCATION, RECORD KEEPING AND HEALTH PROBLEMS

2.1 As mentioned in the introduction volunteers are the most important resource that you can have. For some years now WRG have ensured that new volunteers to Canal Camps are all given a Safety Talk covering all aspects of safety and how the Camp itself will run. This is based on a standard talk which each leader tailors to the project concerned. This has proved to be very helpful not only as protection for the leader, but it also represents a chance to get to know the volunteers and to explain far more than just the safety side of the camp. The standard form of this talk is given in Appendix 5. In addition a "Volunteers' Health and Safety Guide" (known as the "thin green book") containing information directly relevant to the volunteer is given free of charge. These twin actions bring all volunteers, whatever their background, up to speed on Health and Safety matters so that before they go onto site they are all aware of what they can expect and what is expected of them. At least one Canal Trust has taken the green book, modified it to be appropriate to their site and now issues it to all new volunteers.

2.2 Whether given a formal talk or not, all volunteers should be made aware of what will happen if they fail to take their responsibilities seriously. It is WRG policy that any volunteer that acts in an unsafe manner is given one formal warning from the site leader, if they continue to act unsafely then they are asked to leave site.

2.3 It is recommended that details of each volunteer should always be recorded and kept on site in case of emergency. It is for this reason that the authors recommend the use of a standard booking form, even for volunteers who turn up “on the day” or just for an hour or so. It not only has benefits on site but can also be used at a later date for membership recruitment, etc (though please remember the implications of the Data Protection Act). A standard WRG booking form is given in Appendix 3 as this has been found over a period of many years to give all the information needed for the Site Leader. Any form will, of course, be project dependant but WRG have found the one given here to be a good starting point. Where the project demands it (such as a confined space) you may also wish to get all volunteers to sign on and off site in a site log or similar. Any information disclosed should be treated as confidential between the leaders and the volunteer.

2.4 It is necessary for the site leader to have warning (ideally in advance) of any problem that a volunteer brings with them to the site so that he can adjust the works or take appropriate action to ensure no additional risk is created. Some health problems or disabilities may have implications for the type of work a volunteer should be asked to do. Examples of these include epilepsy, asthma and diabetes, to name but a few. There is space on WRG booking forms for volunteers to give notification of any relevant health problems; leaders and those responsible in other situations should take care to ascertain this information. Ideally, any information thus volunteered should be followed up and restrictions clarified before the booking is accepted. If volunteers are likely to require medication (such as an asthma inhaler) then it should be ensured that they take them on site. One item often dismissed as "not important" is any allergies a volunteer suffers from. From practical experience the authors can confirm that this "minor" issue causes a considerable proportion of the incidents on a Camp – it is essential the leader has a record of the volunteers allergies.

2.5 In general, volunteers should not be placed in a situation where, as a result of their health problem, their own safety or that of others may be at risk. For example, someone with epilepsy who experiences random seizures without warning should not work at heights, operate machinery or work in or near water. It is however, not possible to produce a list of “blanket restrictions” for particular disabilities as each individual case is different.

3. SPECIFIC RISKS TO VOLUNTEERS

3.1 Obviously there are many new risks for volunteers on site, the ones listed below are highlighted as they are “specialist” and a new volunteer may not have encountered them before.

3.2 **The water itself:** Ridiculous though it seems many volunteers will not be used to working near water and very few will be used to working from a boat. If your site has such hazards (many, of course, don't) then take care to brief your volunteers well and ensure any personal buoyancy or life saving aids are provided. Regulation 14 of the Construction (Health, Safety and Welfare) Regulations 1996 states that when working on or near water you should:

- take steps to prevent people from falling into water so far as is reasonably practical; and

- ensure that personal protective and rescue equipment is immediately available for use and maintained, in the event of a fall: and
- make sure safe transport by water is under the control of a competent person (the Maritime and Coastguard Agency (MCA) have issued a code of practice

3.3 **Pollution:** This usually means untreated sewage or slurry spillages and these are a rare isolated occurrence. However, if the stretch of canal is urban or near industrial areas then check for pollution. Volunteers should also be made aware of the possibility of dead animals and discarded hypodermic needles. In both cases the procedure should be the same. Clear the immediate area and inform the landowner or authorities. One specific form of water borne hazard is Weil's disease.

3.4 **Weil's Disease (Leptospirosis):** Weil's Disease is a serious, and sometimes even fatal, infection that is transmitted to humans by contact with the urine of infected rats (which may frequently contaminate canal banks and water at work sites). The infection enters the body through breaks in the skin or via the lining of the mouth, nose or eyes. The following preventative measures should be applied:

- All cuts and broken skin must be covered with waterproof plasters and/or gloves.
- Hands should be washed thoroughly before eating, drinking or smoking.
- Contaminated clothing (overalls etc.) should be removed before entering food preparation or eating areas.

3.5 The disease starts with a flu-like illness with a persistent and severe headache. Anyone experiencing these symptoms up to three weeks after being in contact with canal or river water MUST draw the fact to their doctor's attention. The disease is cured in the early stages by antibiotics. See Appendix 6 for a data sheet.

3.6 **Tetanus:** All volunteers should be advised to be immunised against tetanus, which can be contacted even via trivial wounds. Initial immunisation consists of a course of three injections, after which a booster dose is required every ten years to maintain immunity.

3.7 **Cement:** The hazards associated with cement are discussed in PRH chapters "Concreting" and "Health and Safety 1". However, it is highlighted here as it is the most common cause of serious injury in the authors experience. Cement burns and associated long-term skin complaints are very serious and your volunteers should be taught to avoid contact with cement and what to do in the event of contact.

3.8 **Fatigue and musculoskeletal problems:** It is also true to say that many volunteers will also not be used to the potential hard work of canal restoration. A desire to compete or just do their bit can result in them overreaching themselves. Whilst this often only leads to aches and pains the following day the potential for serious long-term damage is considerable. Please read section VIII on manual handling and ensure that your volunteers are aware of the risks.

4. GENERAL MEDICAL FACILITIES

4.1 It is always possible that a volunteer may be taken ill whilst performing voluntary work. It is essential to ascertain the location of the nearest 24-hour casualty department and have a map or easy directions available in an emergency. Where this is some distance away, and the project Camp is of several days'

duration, it may be worth making contact with a local GP surgery in advance to ascertain if they are prepared to see volunteers as temporary patients, should the need arise.

5. FIRST AID

5.1 In a place of work, legislation states that there must be someone responsible for first aid at all times when people are at work. The level of qualification and experience which that person must have depends on a number of factors including the nature of the work being carried out, the risks involved and the number of people employed. It is good practice for everyone on site to be aware of any First Aiders and for them to be easily distinguishable – for this reason WRG provide "First Aider" helmet stickers for any of their volunteers who wish to wear them.

5.2 For a small, low hazard undertaking, cover may be provided by an appointed person. This is someone who is appointed to take charge in an emergency who will call the emergency services and only render first aid for which (s)he has been trained. It is recommended that appointed persons have some first aid training.

5.3 In larger or more hazardous undertakings, qualified First Aiders are required. A First Aider is someone who has completed an approved course, run by an HSE Approved organisation, within the last three years. Examples of these courses are the traditional "four day First Aid at Work" course or the newer "24 contact hours" course. Many Voluntary Aid societies courses would also be acceptable (e.g. St Johns Ambulance).

5.4 Note for WRG groups; when you are working on a restoration site where there is no clearly defined system (such as a CDM structure for safety planning, see PRH "Health & Safety Section 3") then it is the WRG leader who is responsible for ensuring first aid cover is available. WRG aims to offer in-house Emergency First Aid training to those organisers, leaders, assistants and volunteers who wish to receive it. This training is similar to that provided for Appointed Persons in the workplace and leaders should therefore be prepared to delegate first aid responsibility to a more experienced volunteer, such as a doctor, nurse or qualified First Aider, when appropriate. (Providing of course that the volunteer is prepared to accept that responsibility).

5.5 The principles of first aid are:

- To sustain life
- To prevent further injury
- To promote recovery

5.6 It can further be added that, for any serious injury, any treatment given should only be “something to do” whilst you are waiting for the emergency services to arrive! Remember that reassurance and comfort can be as important as strapping limbs up.

What to do in the Event of an Accident

5.7 When an accident occurs involving serious injury, the chances of survival of the casualty will be much improved by the speedy arrival of the emergency services. Channels of communication are particularly important when it comes to getting help to remote work sites. The procedure for calling the emergency

services must be planned in advance e.g. where is the nearest telephone?, what is the name and/or number of the nearest road access?, what is the O.S. grid ref.? etc. These details should be written down and all volunteers should know where to find them.

5.8 If an accident occurs:

- Protect the scene, protect other workers, protect yourself
- Before going to the aid of a casualty, make sure that it is safe to do so – never put yourself, or others, at risk
- Send a competent person to call the emergency services – with as many details as possible
- Reassure the volunteer and make them comfortable (without moving them)
- Administer any first aid treatment within your capabilities

5.9 Never move a seriously injured casualty unless it is essential to do so.

5.10 For some time it has been WRG policy to always ensure that there is at least one "emergency" vehicle available at all times while on site. This is recommended as good practice and the "emergency" vehicle should be "turned round" ready to leave site and the keys should be in a place known by all drivers on site. Some examples where this has proved to be a good idea are:

- where a minor trip to casualty is required
- where a volunteer has unexpectedly taken a dunking in freezing water and needs to return to the hall
- where a volunteer appears to be in the early stages of sunstroke and needs to spend the rest of the day in the shade

Emergency First Aid Treatment

5.11 These notes are for guidance only. Do what you can until the emergency services arrive and always be prepared to hand over control of the situation to someone with appropriate experience and training.

5.12 **Resuscitation:** The priorities are:

A – Airway
B – Breathing
C – Circulation

and they must be dealt with in that order.

- Check for consciousness - 'shake and shout'
- Open the airway of an unconscious casualty by removing any obstructions from the mouth (do not remove any well-fitting dentures), placing two fingers under the point of the chin and lifting the jaw. Place your other hand on the casualty's forehead and tilt the head back
- Check for breathing by listening, feeling for breath on your cheek and watching for chest movements
- Check for a pulse. Feel for the 'Adam's apple', slide your fingers back into the hollow and feel for five seconds for the carotid pulse.

5.13 **If the casualty is unconscious, has a pulse and is breathing, (s)he must be placed in the recovery or semi-prone position**

If the casualty is not breathing, it will be necessary to begin mouth-to-mouth ventilation:

- Ensure the airway is open (as before) and the head is tilted well back. Pinch the casualty's nostrils closed
- Take a deep breath, seal your lips around the casualty's mouth and blow until you see the chest rise
- Remove your mouth and allow the chest to fall. Continue at a rate of 10 breaths per minute, rechecking the pulse after every 10 breaths.

5.14 **If the casualty is not breathing and there is no pulse, it will be necessary to combine mouth-to-mouth ventilation with external cardiac compressions.**

- With the casualty lying on a firm surface, place the heel of one hand approximately two finger-widths above the point where the bottom rib meets the breast bone. Place the heel of the other hand over it and interlock your fingers.
- Keeping your arms straight, press down vertically on the breast bone, depressing it approximately four to five centimetres. Release the pressure.
- Combine this with artificial ventilation by alternating two breaths with 15 compressions. You are aiming for between 60 and 80 compressions per minute. You will need to continue this until help arrives. Do not waste time re-checking the pulse unless there are other visible signs of life returning.

5.15 **Bleeding:** Major bleeding is controlled by pressure. Place a pad or bandage (if available) over the wound and apply pressure whilst elevating the injured part (if practicable). If no dressing is available, use your hands to apply pressure.

5.16 **Burns and Scalds:** First aid treatment is to cool the burnt part with cold water. Remove constricting items such as clothing and jewellery from the burnt area but do not remove anything that has stuck to the burnt area. Do not apply any ointment etc. and do not burst any blisters. Cover the burn with a light, clean, non-adherent material. If the burn is large, lay the casualty down and elevate the legs, checking breathing and pulse every 10 minutes until the ambulance arrives.

5.17 **Eye injuries:** Lay the casualty down to examine the eye. Loose foreign bodies may be removed by irrigation with clean tap water or eyewash solution. Do not attempt to remove foreign bodies which stick to, or are embedded in, the eye. If this is the case, or if there is a wound to the eye itself, cover the eye with a soft pad. Bandage the pad in place, bandaging both eyes to prevent eye movement. Take or send the casualty to hospital - call an ambulance if the casualty cannot otherwise be transported lying down.

5.18 **Shock:** This is of concern for two reasons. Clinical shock for the victim themselves as a result of an injury (keep them warm, elevate their legs if possible and reassure them) but a problem more often overlooked is the shock effect of an accident on other volunteers. This may well be their first experience of work site accidents and it can have an upsetting effect on some. This shock may well be delayed by many hours and a careful eye should be kept on them for some days. Initially you may wish to get them all working together on a simple but absorbing job to take their minds off what has happened. Afterwards check they are happy with the work you have allocated (it can be unnerving to be working in the same area that another volunteer recently had an accident in).

First Aid Boxes

5.19 First aid boxes should contain (example):

- one guidance card (such as "The Fast Guide to First Aid" by St Johns Ambulance)
- 20 sterile, individually wrapped adhesive dressings (plasters)
- 2 sterile eye pads
- 6 triangular bandages
- 6 safety pins
- sterile unmedicated dressings - 6 x medium, 2 x large, 3 x extra large
- sterile water for eye irrigation, 3 x 300ml, if mains tap water is not available
- individually wrapped moist cleaning wipes (if water is not available)
- a pair of blunt-ended dressing scissors may also be kept in the box and it is sensible to include disposable aprons and gloves

5.20 Please note that the example above is a guide for a minimum kit and the works being undertaken may well make it advisable to increase some supplies. This first aid box should accompany volunteers to site: if more than one site is being worked, the appropriate number of boxes should be provided. ('Travelling' first aid kits are of limited use due to the reduced contents and are not recommended for use on construction sites).

5.21 The first aid box should be sealed to stop the contents getting dirty and it should be green with a white cross.

6. ACCIDENT REPORTING

6.1 It is strongly suggested that accident records follow the HSE recommended procedure. This is that accident/treatment records should include:

- Full name and address of injured person
- Occupation (on site)
- Date and time of accident/occurrence
- Date the entry was made
- Place and circumstances of accident, including full details of work being carried out and names and addresses of any witnesses
- Details of injury and any treatment given
- Signature of the person making the entry (and address, if not the injured party)

6.2 All accidents/injuries and treatments should be recorded however trivial they may seem. These records should be kept for a minimum of three years. The simplest way of ensuring all these details are recorded and kept is to include an HSE standard "accident book" (Form B1510) in with the first aid kit.

6.3 In the event of a fatal or serious accident (e.g. broken bones, major lacerations requiring stitches, or any accident resulting in the removal of the casualty to hospital by the ambulance service) full statements should be obtained from any witnesses. The landowner should also be informed (on a BW site this is the Waterway Manager).

6.4 Note for WRG groups: In the case of an accident requiring the emergency services, hospitalisation (other than a visit to casualty) or involving serious equipment damage, which may result in an insurance claim, the Company Secretary or Head Office must be notified as soon as possible. Contact details are given in Appendix 4. The initial report should be as soon as possible by telephone, followed by a detailed written report including casualties/witnesses. In serious cases, statements, plans and measurements may be needed.

7. WELFARE

7.1 Welfare in this case is in the Health and Safety/First Aid sense. Care should be taken to brief your volunteers as to the dangers of heat and cold, dehydration etc. Volunteers may well be unused to spending all day out in the open air and work sites can be very cold and windy or very sunny with little shade. Keep an eye out for early signs of dehydration or hypothermia. Ensure that they take enough clothes to cover up from the sun or keep warm; many thin layers is better than one thick jumper.

7.2 Make sure there is shade and cover from rain where they can dry out clothes and sit in relative comfort. An adequate supply of drinking water is essential. the subject of volunteers welfare is further discussed in PRH "Site Management" and HSE Construction sheets 18 (fixed sites) and 46 (transient sites). Volunteers are exactly that; they do not have to work for you and if they don't enjoy it then they won't come back nor will they tell their friends about how enjoyable it was.

7.3 It is accepted that a residential project is a temporary ‘home’ to volunteers in addition to being a work site and certain other items may be kept in the form of a ‘self-administration’ kit. This may include items such as:

- Paracetamol (no more than 25 tablets)
- High protection factor sun cream
- Cream/lotion for sunburn
- Calamine lotion and/or mild anti-hystamine cream
- Liquid or cream antiseptics have little treatment value but will do no harm, so may be kept if desired
- A pair of tweezers may be kept for the removal of superficial splinters provided they are kept clean

Although called a ‘self-administration’ kit, use of the contents should be supervised by a responsible person.

8. MANUAL LIFTING AND HANDLING

8.1 It is important to use correct methods of handling and lifting in order to reduce the risk of (potentially permanent) injury occurring. Volunteers should be clearly instructed to look after their backs as they are often not used to such intensive effort, be it the long, hard slog of brick laying or the frenetic intensity of a concrete pour. A moment spent showing your volunteers good digging techniques will not only be rewarded by less aching at the end of the day but by a more productive time all round. Gloves and steel toe caps should be available to volunteers should they feel they are needed.

8.2 Some sites or projects may require a formal Manual Handling Assessment. This is where each task of the project is assessed to ensure that all handling and lifting does not present an unacceptable (short or long term) risk to the personnel carrying out the work. This is good practice whether your site falls under Manual Handling Operations Regulations (1992) or not and the basics of any assessment are given below. Two specific areas of risk need to be considered: repetitive handling of small loads and individual handling of large loads. The normal maximum limit for repetitive handling is 25kg and loads above this should not be handled by volunteers on a repetitive basis – cement bags have recently been halved from 50kg for this reason. However it must be recognised that damage can occur with much smaller loads if badly handled. For loads above 25kg the individual task must be carefully checked and if possible avoided. Unfortunately, at some point most canal restorations involve coping stones well in excess of 25kg that usually need to be carefully positioned in difficult places. For these specialist lifts the use of rollers, chocks and bars is essential as are gloves and steel toe caps for any volunteers involved. The most important thing to ensure is that the "point of no return" is never reached, the load should never be out of control and a rest break should be possible at all times during the manoeuvre.

8.3 Volunteers should avoid the ‘macho factor’ (and women are just as guilty of this as men). There is nothing to be ashamed of in asking for help with a lift – never attempt to show off by lifting heavy objects unaided.

8.4 Remember – your spine supports your whole body and protects the central nervous system – don’t take risks. Back injuries can be serious, causing permanent disability – follow these guidelines to reduce the risk:

Make an assessment before starting to lift any load. This assessment will have four components:

- **The load**: not only the weight but the physical size or shape, centre of gravity, and sharp or protruding edges, etc. What is it? Does it contain a hazardous substance? Is it wet or slippery?
- **The task:** where are you lifting from and to? Why are you doing it – is it really necessary? Is there any mechanical equipment available to do the lift for you?
- **The environment:** is there adequate space in which to lift correctly? Are you standing on a firm and secure surface? Is there somewhere you can test the load if you need to lift in stages or if you get into difficulties?
- **The individual:** what about you? Are you physically capable of carrying out this lift or do you need help? Are you wearing the appropriate protective clothing? People with knee problems or weak thigh muscles should not lift heavy loads.

8.5 Having made your assessment – plan your lift. If you are lifting in a group make sure that you are all of a similar build and height. Make one person ‘in charge’ of the lift and all others take instructions from him/her.

The Basic Lift

8.6 This is generally considered to be the foundation of good lifting technique, although in practice, its applications are limited.

- **Foot placement:** start with the load between the feet. The leading foot should be in line with the side of the load, pointing in the direction of movement, toes level with the front edge.
- **Knees bent/back straight**: Bend knees and hips to get down to the level of the load. Tuck your chin in and keep your spine straight. Lean forward slightly to get over the load but don't incline the trunk more than is absolutely necessary. Avoid putting one knee on the floor as this makes for an unstable lifting action.
- **Grip:** It is important to get a full, firm, secure grip on the load. Ideally, grip the load at the upper, outer corner on the side of the leading foot, tilt it slightly and grip the opposite corner with the other hand. In practice, other hand placements may be better depending on the nature of the load and what is to be done with it. Always use gloves.
- **Lift:** Move the load by leaning forward a little, keeping the rear arm straight. Pull the load firmly into contact with the body, moving the rear hand forward along the lower edge. Stand up in one co-ordinated movement, keeping the load in contact with the body throughout. Remember that an individual's maximum lifting capability is from hand to elbow height (when the arms are at rest in a standing position) with the load kept close to the body.

Lowering: Reverse the above guidelines, bending the hips and knees whilst tilting the load to avoid trapping the fingers.

Carrying Loads

8.7 Carrying tasks can lead to the rapid onset of muscular fatigue in the neck, back, shoulders and arms. Where appropriate, it may be better to carry loads on the back or shoulders rather than in front of the body. One arm lifts are not recommended but if necessary then keep your shoulders level and switch hands regularly. To minimise the levels of fatigue, the following guidelines are recommended:

- Use mechanical aids (a wheelbarrow!) wherever possible.
- Keep loads light. Divide large loads into smaller units even if this means more return trips.
- Minimise the distance. A series of short return trips is better than one large carry.
- Take regular and frequent rest breaks.

Pushing and Pulling

8.8 Some research indicates that pushing a load results in a higher loading on the spine than pulling and can fix the rib cage, making breathing difficult. Pulling is therefore probably safer than pushing in an ideal situation, but there are occasions when pushing will obviously be safer, especially where there is a risk of the load getting out of control. It is safer to be above a load on a slope than below it. On the flat, the best way to shift a heavy load is to put your back against it and push it - the drawback with this method is that you cannot see where you are going and so you may need another person to guide you.

Repetitive Handling and Vibration

8.9 Carefully consider any jobs you allocate to volunteers that involve repetitive handling. Many volunteers will be unused to handling objects such as bricks which, although not heavy in themselves, will represent a significant strain if handled repeatedly. Issue gloves if appropriate and rotate volunteers through repetitive jobs. Schedule adequate breaks and keep an eye on volunteers especially the following day as strains and stresses may well take a while to show through.

8.10 Similarly volunteers performing work where vibration is an issue (e.g. demolition with electric or pneumatic breakers) need to be well briefed on the dangers, issued with suitable gloves and have scheduled breaks.

9. FIRE PREVENTION AND CONTROL

9.1 As with most matters of Health and Safety prevention is better than cure. Good housekeeping will go a long way towards preventing fires. Rubbish, paper, oily rags, etc. can ignite spontaneously or by heat and fumes from mechanical plant.

9.2 Prevent means of ignition coming into contact with a fuel/air mixture, e.g. over-heating mechanical equipment, faulty/over-heating electrical equipment, accumulation of material which spontaneously ignites, or by carelessly discarding a cigarette end. A common problem is spilt diesel soaking into acoustic lagging on dumpers, etc. and then igniting from the exhaust.

What is Fire?

9.3 Combustion is a chemical reaction accompanied by the evolution of light and heat. Three basic components are necessary before combustion can occur:

- A combustible substance (the fuel)
- Heat
- Oxygen

9.4 When a flammable substance is heated to a certain critical temperature (called its ignition temperature) it will ignite and continue to burn as long as there is fuel, the proper temperature and a supply of oxygen. Knowledge of this chemical reaction forms the basis for knowing how to extinguish fire. Heat can be taken away by cooling, oxygen can be taken away by excluding the air, and fuel can be removed.

9.5 **Cooling:** In order to extinguish a fire by cooling it is only necessary to absorb a small portion of the total heat being evolved by the fire. The most common and practical agent is water applied in the form of a solid stream, finely divided spray or incorporated in foam.

9.6 **Removing the Fuel:** Taking the fuel away from the fire can be difficult and dangerous, but there are exceptions. Escape of flammable gases, from a leaking pipe or connection can be stopped by turning off the valve and stopping the flow of fuel; the fire will then go out. Fire caused by an electrical fault MUST have the supply isolated immediately, to prevent electrocution and to help reduce heat at the fault.

9.7 **Limiting Oxygen:** Excluding air (oxygen) from a fire can be accomplished through smothering, by covering the burning area with fire blanket, or foam from an extinguisher, or even throwing sand or earth on the fire.

9.8 Extinction of a fire by diluting the reactants, oxygen and fuel vapours below the concentration necessary to support combustion can be accomplished by blanketing the fire area with carbon dioxide (CO_2).

Types of Fires and Extinguishers

9.9 Fires are commonly divided into groups and different types of extinguishers are required to fight them. It is important the correct extinguisher be used, the wrong choice (e.g. water on an oil fire) may well make the situation worse. Previously the bodies of fire extinguishers were colour coded as to which fire it could be used on, however recent legislation means that now the body of the fire extinguisher is red with an (optional) identification colour panel. Fortunately the new colour codes for the panels are the same as the old codes for the bodies.

Fire Groups:

Group "A" fire involves solid materials, usually organic materials, in which combustion involves the formation of glowing embers, i.e. materials smouldering, such as wood, cloth, paper etc. This category of fire is usually put out by cooling, with the use of water, but in enclosed and confined spaces can be extinguished by smothering with the use of a dry powder extinguisher, or a CO_2 (Carbon Dioxide) type.

Group "B" fires involve flammable liquids, i.e. petrol, oils etc., or solids which melt when heated to form liquids. These types of fires are put out by smothering, using CO_2 or by using foam which both cools and smothers the fire.

Group "C" fires involve electrical and gas based fires which cannot safely be dealt with by foam. These fires are also smothered by using special powders and CO_2 extinguishers.

N.B. Volunteers are advised not to use Halon (BCF) extinguishers (GREEN colour code).

Fire Extinguishers:

TYPE	COLOUR	USE	NOT FOR USE ON
Water	RED	wood, paper, textiles, fabric etc.	burning liquid, electrical or flammable metals
Foam	CREAM	burning liquid	electrical or flammable metals
Powder	BLUE	burning liquid	flammable metals, electrical
Carbon dioxide	BLACK	burning liquid	flammable metals
Halons (BCF)	GREEN	burning liquid	flammable metals

Fire Fighting

9.10 Do not tackle a fire unless you are certain it is safe to do so. Unless you are absolutely confident that you can deal with the fire by yourself then call the Fire Brigade. The procedure for calling the emergency services must be planned in advance e.g. where is the nearest telephone?, what is the name and/or number of the nearest road access?, what is the O.S. grid ref.? etc. These details should be written down and all volunteers should know where to find them.

- When tackling a fire always aim the extinguisher's jet at the base of the burning material.
- Where there is a strong wind or draught then extinguish from upwind to downwind.
- Always make sure that you have a safe means of escape.
- If a person's clothing is on fire don't hesitate to use a water or powder extinguisher on them. Alternatively throw a rug or blanket over them to smother the flames, or roll them on the ground.
- As soon as possible cool any burnt skin with cold water and leave it cooling for five minutes.
- Do not attempt to remove burnt clothing.

Fire as a Tool

9.11 It is a condition of IWA/WRG Insurance that the following rules are followed for management of fires and other heat sources. If your site participates in IWA/WRG cover then it must follow these rules:

Burning of Debris: The following precautions must be observed:

- Fires must be in a cleared area and at least 9 metres distant from any property.
- Fires not to be left unattended at any time.
- Suitable fire extinguishers to be kept available for immediate use.
- Fires to be extinguished at least one hour prior to leaving the site at the end of each working day.

Heat Application: These conditions must be observed wherever a naked flame or open heat source is used.

- Work area to be cleared of combustible material below where work is being undertaken and to a safe distance, i.e. not less than 6 metres where welding/cutting are involved. Where this is impracticable, combustible material will be covered with asbestos blankets or similar protective equipment and combustible parts of premises to be similarly protected.
- Fire extinguisher of a suitable type to be kept immediately adjacent to the work area and available for immediate use.
- Equipment must be lit as short a time before use as possible and immediately extinguished after use. Lighted equipment must NOT be left unattended.
- A thorough examination for signs of combustion to be made within or below the work area in which work has been undertaken half an hour after the termination of each work period.

10. CONTROL OF DRIVERS AND OPERATORS

10.1 Consider carefully how you are going to control who drives what (and when, and where) on your site. Apart from the serious Health and Safety implications of an "anything goes" policy there are practical advantages to running a tight ship - at least you know where the van, dumper, excavator is when you need it.

10.2 WRG have for some years now operated a Driver Authorisation scheme which has satisfied our insurers and other bodies such as British Waterways. For groups that participate in the insurance cover arranged by IWA/WRG this scheme is mandatory but even for groups who obtain cover from elsewhere it is

strongly recommended that they participate in the WRG Driver Authorisation scheme as this gives an easy check on who is competent to operate equipment.

10.3 The system comprises of 14 classifications of plant and two grades of user: operators and instructors. Operators have been given basic instruction on safe operation of a particular class of plant and have gained enough "hands on" experience (under an instructors supervision) to be safe to operate that plant (or at least to realise when they need additional advice to assess a risk). At this point he applies for an "operator card" on a form available from the instructor or Head Office.

10.4 The experience given on the form will be assessed by the WRG Board or appointed representative. If satisfied then the volunteer will be issued with a laminated card that will give classes of equipment he is authorised to operate. Once sufficient experience has been gained on a wide variety of sites and jobs, not only of operation but also maintenance, then the operator may apply for instructor status. Their experience and ability to teach others will again be assessed by the WRG Board. Once this is granted they may instruct others who may then apply for operator status. A consistency check is that instructors all work from a series of guidance sheets written by experts that cover the main points and they elaborate from there based on their own experiences. The classes that are covered are:

1. Vans
2. Land Rovers
3. Trailers
4. Barrow Hoists
5. Small Cranes
6. Dumpers
7. Smalley Excavators
8. Skid steer Loader
9. Small track laying excavators
10. Large track laying excavators
11. JCB3 (and Clones)
12. Draglines
13. Work Boats
14. Other

Category 14 is an additional category that allows odds and ends (such as telescopic loaders or tractor mounted winches) to be included in the scheme.

10.5 Further guidance on the operation of vehicles, plant and equipment is given in the PRH "Vehicles and Trailers" and "Plant". It is strongly advised that these are studied and any recommendations taken on board. Please note that there are several other requirements for anyone who wishes to drive or operate equipment insured under cover granted through participating in the IWA/WRG insurance in addition to the issuing of a Driver Authorisation card. These minimum requirements are listed in the next section.

10.6 Remember this scheme is meant to make restoration work safer, not to limit the number of drivers or operators. If you want to learn how to operate an item of plant or drive a vehicle then ask the site leader and then find an Instructor.

11. IWA/WRG INSURANCE COVER

11.1 The IWA has, for many years, arranged first class insurance cover at very competitive premiums for the IWA, its subsidiary companies and participating corporate members. It is a condition of participation in the insurance cover that corporate membership of the IWA must be current. The premiums paid by corporate members are usually considerably less than premiums quoted to individual clubs/Societies trusts for similar independent policies. Corporate membership details are available from IWA Head Office. Please note that the relationship between IWA and their brokers is excellent and the IWA will work very hard to keep it that way. All of the details given below are subject to change as the IWA negotiates improved conditions. **Please note that all dealings with insurance should be via the Insurance Officer or the Events Insurance Officer, as appropriate. In the first instance contact should be via IWA Head Office.**

11.2 WRG groups have public liability cover for their normal activities. For other groups, Societies, Trusts etc. the IWA can offer inclusion in the following categories: Public Liability, Loss of Money, Group Personal Accident, Employers Liability and Property. Further policies provide Contract Works Cover, Plant Cover, Motor Cover and Marine Liability (a policy specifically written to provide appropriate cover if you organise “events” connected with, or on, water or if you are legally responsible for moorings, slipways, etc.).

11.3 With regard to events, providing you have taken out annual public and marine liability insurance cover you will not need an insurance extension when organising socials, boat gatherings, rallies, festivals, etc. However, it is a requirement for participation in our insurance that all events (other than normal activities of a restoration group) are registered with the IWA Events Officer. He will advise whether or not anything you intend to do will put yourselves or the IWA at risk.

11.4 It is essential that any "material fact" you are aware of is declared to the Insurers (via the IWA Officers). In this case a material fact is any activity outside the "expected norm". The classic example of this is the fairground ride at a boat rally. Unless specifically declared to the Insurers this ride would not be covered for public liability. It is not sufficient just to determine that the fairground owner has their own insurance cover. In the event of an accident, should the equipment owners insurance cover prove inadequate then the claim may well revert to the IWA policies. If our Insurers are unaware, i.e. material facts have not been declared, they will probably deny responsibility and the claim will end up back with the organisers. Thus a failure to declare material facts could well render the organisers legally liable. The IWA Events Officer can advise further. Another material fact that must be declared is the letting off of fireworks at your event.

11.5 Some comments on these individual policies:

Public liability – This provides indemnity for public liability in respect of third party accidental injury or property damage – includes individual member indemnity and member to member indemnity. Limit of indemnity is £2.5M (increased to £5M where required by Local Authority). As a guide premiums range between £65 and £115pa. This is essential cover if you are doing any active work on your project.

It is also this cover that is relevant for a frequent problem area – temporary use of halls, etc. Cover has recently been extended so that free loan of premises for meetings is covered (for damage to the building and its contents). The use of IWA members homes for meetings is included in this cover. However, if you do pay a fee for hire of a hall or other meeting place it is essential that proof is obtained of doing so. It is also important that you do not sign any document concerning liability without first checking it is within

the scope of the IWA public liability cover. If not then you may well be personally liable for any damage. This additional cover does not extend to longer occupation of Third party premises e.g. accommodation for Canal Camps. A fuller briefing note is available from IWA Head Office.

Group Personal Accident – Age range 15 - 74 years inc. Premium approx. £12pa. Benefits are £15k for death, loss of limb(s) or eye(s) and permanent disablement from occupation.

Loss of money – Sums covered depend on location and circumstances. Present premium is approx. £10.

Employers liability – Minimum premium £50pa. Individual cover for each employing Society or Trust. Indemnity limit £10M.

Property Schedule – Categories included are buildings, contents, sales stock and trophies, rally equipment, temporary buildings and waterway structures (Note that caravans and trailers are insured as rally equipment and must be fitted with a wheel clamp, towing socket lock or other approved security device). The categories on the property schedule each have different premiums but all property is subject to a generous 33% discount. Insured value basis is the replacement cost with a £250 excess, except for damage by fire or lightning.

Contractors All Risks (Royal and Sun Alliance)
This premium provides insurance cover for your project works, plant and materials should they be damaged by an insured peril (such as fire, theft, malicious damage). Note that it will not cover the actual existing structure being worked on (if there is any!). Premiums vary according to the value of the works insured. Insured value basis for plant and tools is current market value.

Marine Liability (Eagle Star – Navigators)
This policy provides an indemnity of £1M for any one accident against waterborne risks only for claims made and law costs incurred by third parties for which you may become legally liable. This is a must if you are going to run events and should be seriously considered if you own or are responsible for moorings, slipways, marina facilities. The minimum present premium is £56.25pa. It is stressed that the policy does not provide any cover in respect of navigational risks (these can be insured under specific Marine Hull policies).

Motor Policies (Cornhill)
Our policies provide for cars, vans, minibuses etc., belonging to the participating body. Loan vehicles can be accommodated with prior notification. Items of plant such as dumpers can be insured for road use. Each vehicle is quoted separately. The insurance of motor vehicles has minimum requirements for anyone who wishes to drive a vehicle insured under IWA policies. These are given below.

11.4 For Road Going Vehicles a driver must:

- Be 25 years of age or over
- Have held a full driving licence for this class of vehicle for one year
- Have no current endorsements on their licence
- Have no medical condition which requires notification to DVLA
- Have no special terms currently imposed on their own policies
- Have their driving licence on their person (see below)
- Be a competent driver of that type of vehicle
- Be authorised by the keeper of the vehicle to drive it

- Be entirely sober and unimpaired by drugs or medicines
- Hold a WRG Driver Authorisation Card for that category of vehicle

Please note that by special application to the WRG Board (who administer the Driver Authorisation scheme) one or more of the first 5 points may be relaxed and a Driver Authorisation card can be issued.

11.5 For on site plant an operator must:

- Have held a full driving licence for one year
- Have no current endorsements on their licence
- Have no medical condition which requires notification to DVLA
- Have no special terms currently imposed on their own policies
- Have their driving licence on their person (see below)
- Be a minimum of 17 years of age (or whatever the legal minimum age for that category is)
- Be a competent driver of that type of vehicle
- Be authorised by the site leader to drive it
- Be entirely sober and unimpaired by drugs or medicines
- Hold a WRG Driver Authorisation Card for that category of equipment

11.6 Again by special application to the WRG Board one or more of the first 4 points may be relaxed and a Driver Authorisation card can be issued.

11.7 Where an item of plant goes on the road (assuming it is legal to do so) then the operator must also have authority to drive at least one category of Road Going Vehicle.

11.7 For WRG groups: Every vehicle has an official keeper and permission must be obtained from that keeper before authorisation is given to drive. This keeper will most likely be the site leader for any working party. Remember that permission to drive a WRG vehicle must be obtained from the official keeper for each time you wish to drive it. This will ensure that when the site leader has an urgent need for a van (s)he knows where they are.

11.8 The procedure to be followed in the event of a vehicle or plant accident should be well communicated to all volunteers. For WRG Groups they are given in Appendix 4.

11.9 All WRG vehicle documents are held at IWA head office in Rickmansworth and they will be produced at Rickmansworth police station if requested. It is for this reason that it is necessary to carry your licence with you so that, if requested by the police, you can provide your licence at the time to avoid having to journey to Rickmansworth (or wherever your vehicle documents are kept) to present your licence then.

APPENDIX 1 - LIST OF TEXTS AND PUBLICATIONS REFERENCE IN PRH "HEALTH & SAFETY SECTIONS 1-4"

Note that texts are listed under the section of the guide in which they are primarily referenced but may also be referred to in other sections. It is recommended that these texts are obtained as they will assist greatly with Health and Safety planning.

Section 1 - Site Aspects

Code	Title	Available from
	HSE Construction Summary Sheets	
SS2(rev)	Safe Use of Ladders	HSE
SS3 (rev)	General Access Scaffolds	HSE
SS6	Portable Electric Tools and Equipment	HSE
SS8 (rev)	Safety in Excavations	HSE
SS11(rev)	Safe Use of Propane and other LPG cylinders	HSE
SS12	Flame Cutting and Welding with Compressed Gases	HSE
SS16	The Control of Substances Hazardous to Health	HSE
SS17	Construction site Health and Safety Checklist	HSE
SS26	Cement	HSE
SS28-35	Your Body at Risk: Are you Properly Protected?	HSE
SS50	Personal Protective Equipment: Safety Helmets	HSE
na	Noise in Construction	HSE
na	Construction (Working Places) Regulations 1966	HMSO
na	Carriage of Dangerous Substances in Packages Regulation	HMSO
na	Health and Safety at Work Act	HMSO

Section 2 - Personal Safety and Insurance

Code	Title	Available from
green book	Volunteers' Health and Safety Guide	WRG
B1510	Accident Record Book	HSE
IND(G) 84L	Leptospirosis - are you at risk?	HSE
SS18	Provision of Welfare at Transient Construction Sites	HSE
SS46	Provision of Welfare at Transient Construction Sites	HSE
SS51	Construction Fire Safety	HSE
na	Insurance Briefing notes (various)	IWA

Section 3 - Construction Design and Management Regulations

Code	Title	Available from
na	Construction, Design and Management Regulations 1994	HMSO
F10	Notification of project to HSE	HSE
C400	CDM Regulations - How the Regulations affect you!	HSE
SS17	Construction Site Health and Safety Checklist	HSE
SS40	The Role of the Planning Supervisor	HSE

SS44	The Health and Safety File	HSE
	Guide to the Provision and Use of Work Equipment Regulations 1998	HMSO
	Guide to the Lifting Operations and Lifting Equipment Regulations 1998	HSE
F91/CE	Lifting Appliances Record	HMSO
F91/A	Scaffolding Record	HMSO
F91/J	Lifting Gear Record	HMSO
F91/B	Dam Inspection Record	HMSO
F2202	Welfare Arrangements Record	HMSO
na	Volunteers Working Safely	BW

Section 4 - Control of Substances Hazardous to Health

Code	Title	Available from
	Legal Acts	
na	Control of Substances Hazardous to Health 1998 & 1994	HMSO
na	Health and Safety at Work Act, 1974, 1992	HMSO
na	Factories Act 1961 Revised	HMSO
na	Health and Safety Information, Employees Regulations 1989	HMSO
na	Highly Flammable Liquids and Liquified Petroleum Gases Regulations 1972	HMSO
na	Approved Code of Practice Control of Substances Hazardous to Health 1994 (ACOPS)	HMSO
	Health and Safety Executive Guidance Notes	
	Environmental Hygiene Series:	
EH17	Petroleum based adhesives in Building Operations	HSE
EH8	Arsenic: toxic hazards and precautions	HSE
EH9	Spraying of highly flammable liquids	HSE
EH16	Isocyanates: toxic hazards and precautions	HSE
EH22	Ventilation of Buildings	HSE
EH26	Occupational Skin Diseases: Health and Safety Precautions	HSE
EH40	Occupational Exposure Limits (Revised Annually)	HSE
EH42	Monitoring Strategies for Toxic Substances	HSE
EH43	Carbon Monoxide	HSE
EH44	Dust in the Workplace: general principles of protection	HSE
EH46	Exposure to Mineral Wools	HSE
	General Series	
GS5	Entry into Confined Spaces	HSE
GS29/4/	Health and Safety in Demolition Work. Part 4	HSE
GS46	In Situ Timber Treatment using Timber Preservatives; health and environmental precautions	
	Medical Series	
MS8	Isocayanates; medical surveillance	HSE
MS15	Welding	HSE

	Hazard Information Sheets	
No. 1	Cements 1985	HSE
No. 5	Solvents 1988	HSE
No. 7	Skin Hazards 1988	HSE
No. 8	Pesticides 1989	HSE
	Construction Summary Sheets	
SS15	Confined Spaces 1988	HSE
SS24	Chemical Cleaners	HSE
SS26	Cement	HSE
SS27	Solvents	HSE
SS36	Silica	HSE
	Respiratory Protective Equipment	
BS4275	Recommendations for the selection, use and maintenance of Respiratory Protective Equipment 1974	HSE
	Respiratory Protective Equipment (RPE): Legislative Requirements and lists of HSE approved standards and type approved equipment 1989	HSE
	Health Safety Leaflets	
	Introducing COSHH. A brief guide for all employers to the the requirements for controlling hazardous substances in the workplace	
	Introducing Assessment: a simplified guide for employers	
	Managing Health and Safety in Construction	
	Part 1: Principals and Applications to main contractor/ visiting group projects. HMSO 1988	
	Part 2: Management Contracting HMSO 1988	
	Hazard and Risks Explained	
	Control of Hardwood Dusts 1987	
	Health Hazards to Painters 1989	
	Miscellaneous Documents	
	A Guide to Safe Use of Chemicals in Construction	CIRIA
	Construction Safety Manual : Section 25	BEC/BAS
	Development of Contaminated Land; Dept. Of Environment Circular 21/87	DoETR
	COSHH In Construction : A BEC Guide	BEC
L101	Safe Work in Confined Spaces	HSE

Addresses

Health and Safety Executive
HSE Books
PO Box 1999
Sudbury
Suffolk
CO10 6FS

HMSO
Any Local HMSO bookshop

Ciria
6 Storeys Gate
Westminster
London,
SW1P 3AU
0171 222 8891
www.ciria.org.uk

BEC Publications
Federation House
2309 Coventry Road
Sheldon
Birmingham
B26 3PL
0121 742 0824

Inland Waterways Association
Waterway Recovery Group Ltd
PO Box 114
Rickmansworth
WD3 1LT
01923 711114

APPENDIX 2 – ORGANISATIONS PARTICIPATING IN IWA/WRG INSURANCE SCHEME

Please note that this list of participating members is not set in concrete. There may be lapsed members or new members who have been included after publication. Contact the IWA Insurance Officer (via IWA Head Office) for details of current membership.

The INLAND WATERWAYS ASSOCIATION

And its Subsidiary Companies,

And participating Corporate Members and their subsidiaries as detailed below:

Anderton Boat Lift Trust
+ Friends of Anderton Boat Lift
Ashby Canal Association
+ The Ashby Canal Co. Ltd (trading arm of the Association)
Ashton Packet Boat Co.
Association of Independent Museums
Association of Waterways Cruising Clubs (AWCC)
Aston Clinton Boat Club
Barnsley Canal Group
Basingstoke Canal Boat Club
Birmingham Canal Navigations Society
Black Country Boating Festivals
Boats for the Handicapped
Brighouse & Sowerby Bridge Boat Club
Buckingham Canal Society
Bude Canal Society
Bude Canal Trust Ltd
Burslem Port Project
Calder Navigation Society
Chesterfield Canals Trust
Chichester Canals Society
+ Chichester Canal Trading Ltd
Chiswick Pier Trust
Combeswood Canal Trust
Cotswold Canal Trust
+ Cotswold Canals Trust (Trading) Ltd
Crooke Cruising Club
Derby and Sandiacre Canal Trust
+ Derby and Sandiacre Canal society
Driffield Navigation Amenities Association
Driffield Navigation Trust the
Droitwich Canals Trust
+ Droitwich Canals Cruises Ltd
Dudley Canal Trust

Erewash Canal Preservation and Development Association
Forth & Clyde Canal Community Project
Forth & Clyde Canal Society
Foxton Inclined Plane Trust
Fradley Junction Cruising Club
Friends of the Chelmer & Blackwater Navigation
Friends of River Kelvin
Furness Vale Boat Club
Garth Allan
Grand Union Canal Society
Grand Western Canal Association Ltd (formerly Grand Western Canal Trust)
Grantham Canal Restoration Society Ltd
Grantham Canal Partnership
Greenwood Centre
Greyhound Boat Club
Hereford and Gloucester Canal Trust
I.F. Kemp Boat Services
Inland Waterways Protection Society
Kensal Rise Association of Boaters Ltd
Kent & East Sussex Canal Restoration Group
Lancaster Canal Trust
Lapal Canal Trust Ltd
Lichfield and Hatherton Canals Restoration Trust Ltd
Littleborough Historical and Archaeological Society
Louth Navigation Trust
Macclesfield Canal Society
Manchester Bolton and Bury Canal Society
Manchester Steamship Society
Manchester Taxi Drivers Org, for Handicapped Children
Melton and Oakham Waterways Society
Monmouth, Brecon and Abergavenny Canals Trust
Neath & Tennant Canal Preservation Society
Newbury Working Party Group
North Cheshire Cruising Club
Old Union Canal Society
Noted interest of BW in conjunction with Old Union
Osborn-Wood Turners
Oxford House (RISCA) History Society
Paisley Canal and Waterways Society
Peter Mountford (Blacksmiths)
P. Speight Narrowboat Painting Service
Pocklington Canal Amenity Society
Proprietors for the Stroudwater Navigation
Regents Canal Boat Owners Association
Residential Boat Owners Association
Ribble Link Trust
Rickmansworth Waterways Trust
River Bann and Louch Neagh Association

River Stour Trust
Rochdale Canal Society
Friends of Sowerby Bridge
Sale Cruising Club
Saltisford Canal Trust
+ Saltisford Canal Trading Ltd
+ Saltisford Association of Moorers
Sankey Canal Restoration Society
Scottish Inland Waterways Association
+ Edinburgh Canal Society
+ Broxburn Union Canal Society
Severn Navigation Restoration Trust
Shropshire Union Canal Society
Sleaford Navigation Trust
+ Sleaford Navigation (Sales) Ltd
Somerset Navigators Boat Club
Somersetshire Coal Canal Society
+ The Dorset and Somerset Canal Society
Southampton Canal Society
South Pennine Boat Club
South Staffordshire Narrowboat Co Ltd
Stratford upon Avon Canal Society
Surrey and Hants Canal Society
Swansea Canal Society
Symbol Restoration Society Ltd
Thames and Medway Canal Association
Thames Explorer Trust
Thome Cruising Club
Thrupp Canal Cruising Club Ltd
Trent & Mersey Canal Society
Tudor Cruising Club
Water Adventure Centre
Weighbridge Cruising and Social Club
Wendover Arm Trust
West Glamorgan Rainbow Boat Trust
West Kilbride Museum Society
Wey & Arun Canal Trust Ltd, The
+ W&A Enterprises Ltd
Whitchurch Waterway Trust
White Rose Boat Club
Wilts & Berks Canal Amenity Group
Wooden Canal Boat Society Ltd
Worcester Birmingham Canal Society

Boat Museum Trust Ltd
Huddersfield Canals Group
Royal Naval Museum

APPENDIX 3 – VOLUNTEER REGISTRATION FORM

canal camps application form

First name _____ Surname _____

Address _____

_____

Postcode _____ Tel. no. _____

Date of birth _____ Occupation _____

I wish to attend the following Canal Camp(s):

camp no _____ at _____ dates _____

camp no _____ at _____ dates _____

I enclose payment of £ _____ (Cheques should be made payable to "WRG Camps A/c")

Any special diet? _____

Do you possess a valid, clean UK driving licence? YES/NO

Do you possess a WRG plant operator's authorisation? YES/NO

If YES, please give category numbers _____

Have you been on a Canal Camp before? YES/NO If so, how many/where/when:

_____

Are you attending the camp as part of your Duke of Edinburgh's Award? YES/NO

Do you suffer from any illness, such as epilepsy, about which we should know? YES/NO

(if YES, please give details in a covering letter)

How do you intend to travel to the camp? _____

How did you first hear about Canal Camps? _____

In the unlikely event that you should injure yourself, whom should we contact?

Name _____ Tel. no. _____

Signed (Parent's signature necessary if you are under 18) _____

Please return this form to:

APPENDIX 4 – ACCIDENT REPORTING PROCEDURE AND CONTACT DETAILS FOR INSURANCE

In the case of an accident involving:

- attendance by the emergency services, or
- hospitalisation of a volunteer (other than a visit to casualty), or
- a member of the public, or
- serious vehicle equipment or plant damage

which may result in an insurance claim, the Company Secretary or WRG Head Office must be notified as soon as possible. This is in addition to any procedure that may be outlined in local Health and Safety plans.

The initial report should be as soon as possible by telephone, followed by a detailed written report including casualties/witnesses. In serious cases, statements, plans and measurements may be needed. The landowner should also be informed (on a BW site this is the Waterway Manager).

Christopher R Davey
WRG Company Secretary
c/o Inland Waterways Association
3 Norfolk Court
Norfolk Road
Rickmansworth
WD3 1LT

Tel. 01923 711114

For all WRG owned vehicles the legal documents are held at WRG Head Office in Rickmansworth. If the police request to see them then these documents will be presented by Head Office Staff at Rickmansworth Police Station. It is the drivers responsibility to make this request to Head Office. It is the drivers responsibility to present his license at the time of the incident.

For information purposes our insurance brokers are the Leicester Branch of AON Risk Services, however, please make first contact via IWA Head Office.

APPENDIX 5 – A SPECIMEN SAFETY TALK FOR VOLUNTEERS

CANAL CAMP NO: _____ LEADER: _____

Please use the guidelines below and overleaf for your safety talk.
Please note down below any extra points you made which you felt were valid.

Once the talk has been completed then they must sign the form on page 4 to say they have read the small H&S leaflet, listened to your safety talk and agree to follow your instructions.

At the end of the camp send all 4 pages to Neil Edwards where they will be kept on record.

GENERAL

- Welcome them properly and introduce everyone.
- Explain the importance and relevance of the work they will be doing.
- Explain how the Campleader is in charge and how WRG is responsible for them 24 hours a day.
- Explain how they have "a responsibility for their own safety and the safety of others around them" (quote from H&S at Work Act).
- Explain the leadership hierarchy (usually leader > assistant > local)
- Outline exactly the procedure to be followed in an emergency.
- Show them the Large Health and Safety Guide and explain where it will be available for consultation on site. (We recommend taking one of the flight cases on site and keeping all documentation in that).
- Explain that if they are not happy with anything, please tell the leader.
- Explain that they are responsible for possessions or valuables.
- Tell them if they break any rules then they will be given one firm warning only. If they continue to break the rules then they will be sent home.
- Ensure they have all read a copy of the "Volunteers' Health and Safety Guide". Ask if there are any questions and collect any DoE books.

ADDITIONAL POINTS MADE:

SAFETY CONSIDERATIONS FOR THE WORK SITE

Work

- Always have the jobs fully explained, do not guess.
- Don't do the job if you are unhappy (e.g. you are bored or unsure)
- If unsure of the details then ask again.
- Do not work solo (i.e. out of earshot or eyesight).
- Don't copy but learn.
- Ignore "Old Hands" who should know better.
- Report any dangerous practices or near misses to the Leader.
- Tell them that if they leave the site then tell the leader.
- "A tidy site is a safe site"

Tools

- Keep them clean
- If they break a tool then they must make it safe and tell the leader.
- Put tools back where you found them.
- Do not misuse them. "The right tool for the right job".
- When they are not being used store them safely.

Plant/Vehicles

- Explain who is allowed to drive what (and only if asked to by the leader).
- Explain the Driver Authorisation card scheme.
- Explain how any volunteer can ask to see anyone's card.
- Explain the importance of good maintenance as well as safe operation.
- Explain where to put keys and starting handles when not in use.
- Explain how machine operators may have limited vision.
- Explain how volunteers should avoid crush zones, etc.

Safety Equipment

- Where appropriate mention the CDM Site Safety Plan, including its location.
- Hard hats/Toe caps/Gloves/Goggles/Dust masks/Ear defenders. Explain how all of these should be provided in decent condition.
- Volunteers will be told when to use them and they must do so.

- Do not continue with the jobs if they are unhappy with the H&S equipment.
- If any safety equipment is broken then tell the Leader.
- Explain about the radios and the phone and show how to use them.

First Aid

- Find out who is a First Aider
- Explain where the First Aid Kits are (Vans/accommodation/site)
- If they use anything from a kit then please arrange its replacement (via the leader)
- Fill in the Accident Book for any accident or hazardous occurrence and tell the leader immediately.
- Beware the effects of extreme heat (cold drinks/sun block/long sleeves).
- Beware the effects of extreme cold (hot drinks/many layers).

COSHH (Note: all relevant data sheets are in all of our vans)

- Explain carefully the handling procedures for any hazardous materials they may encounter (especially cement and fuels).
- Weils disease. Wash it and cover it. Explain the symptoms.

Particular Site Hazards

- Public Right of Way (always consider the risk to Joe Public).
- Fire risks.
- Deep/Toxic water or mud.
- Landowners.
- Dodgy people around.

SAFETY CONSIDERATIONS FOR THE ACCOMMODATION

How the system works

- Explain what jobs will be on a rota system (cooking, washing up, cleaning up).
- Explain where the rotas will be found.
- Explain where van/hall/plant/etc. keys should be kept.

* Explain how the sober person/duty driver system works.
* Explain how the hall is their home for the next week and consideration for others and keeping it clean will make all the difference. “A tidy Hall is a happy Hall”.

- If they leave the accommodation then tell the leader.

Safety

- Location of First Aid kits (if any item is used tell the leader).
- Location of Fire exits (do not block).
- Location of Fire extinguishers.

* No smoking.

Catering

- Explain just how important the cook is!
- Make sure they have given all their allergies/hates/requirements to the cook for him/her to ignore.
- Explain when meals will be served.
- Explain the brewing up kit (keep the Burco full!).

* Don't go hungry, use the toaster.

Other points

- Ensure they have given all details of any medication to the leader (very important point).
- The cook can obtain specialist shopping if asked nicely.

* There may be other users of the hall. Explain the procedure for making sure their kit isn't interfered with.

* Explain about any Hall caretaker.

- Tell them where the nearest payphone is.

Socialising

- Mention any trips to showers or swimming baths.

* Explain any other possibilities (cinema, slide show, bowling, mystery tour, etc.) and see what happens.

- Explain there is no compulsion to drink alcohol or even to go out with the main group but under 18's must be accompanied.

NOTE:
Points labelled with * may be omitted at the Camp Leaders discretion.

Camp No: _____ Site: _____ Date: _____

Leader: _____ Assistant: _____ Talk given by: _____

Health and Safety Declaration:

I have read and understood the WRG "Volunteers Health and Safety Guide" given to me and agree to abide by it. I was also present at a safety talk given by the Canal Camp leader (or an appointed substitute) and agree to follow any instructions given then or subsequently by the Camp leader or assistant.

(Note: This information will be kept on record.)

Name:	Signature:	Name:	Signature:

APPENDIX 6 - LEPTOSPIROSIS - FURTHER INFORMATION

What is Leptospirosis?
Two types of Leptospirosis infection affect workers in the UK:

> **Weil's disease** - this is a serious and sometimes fatal infection that is transmitted to humans by contact with urine from infected rats.
>
> **Hardjo form of Leptospirosis** - this is transmitted from cattle to humans.

What are the symptoms?
Both diseases start with a flue like illness with a persistent and severe headache.

Who is at risk?
Anyone is at risk who is exposed to rats, rat or cattle urine or to fetal fluids from cattle. Farmers are now the main group at risk for both Weil's disease and cattle Leptospirosis: the cattle form is a special risk for dairy farmers. Other workers who have contracted Leptospirosis in recent years include vet meat inspectors, butchers, abattoir and sewer workers. **Workers in contact with canal and river water are also at risk.**

How might I catch it?
The bacteria can get into your body through cuts and scratches and through the lining of the mouth, throat and eyes after contact with infected urine or contaminated water such as sewers, ditches, ponds and slow flowing rivers. Rat urine may also contaminate animal feed stuffs on farms.

How can I prevent it?
Get rid of rats. Do not touch them with unprotected hands.
Consult your vet about the cattle infection.
Cover all cuts and broken skin with waterproof plasters before and during work.
Wear protective clothing.
Wash your hands after handling any animal, or any contaminated clothing or materials and always before eating, drinking or smoking.

What else should I do?
Report any illness to your doctor. Tell the doctor about your work and show this text.
Leptospirosis is much less severe if it is treated promptly, if your Doctor decides you have Leptospirosis tell your site leader who should then report it to the Health and Safety Executive.

To your doctor
The volunteers work may expose him/her to the danger of Leptospirosis (either L. icterohaemorrhagiae or L. Hardjo). Early diagnosis and treatment are vital in Weil's disease as jaundice is often absent in the early stages. The illness in L. Hardjo may also be greatly shortened by appropriate antibiotic treatment. (Your local Public Health Laboratory Service or hospital consultant microbiologist should be able to offer advice and serological testing).

You or your doctor can get further information from the Employment Medical Advisory Service at any office of the Health and Safety Executive.

Text taken from HSE document IND(G)84L. Current at 2/90.

Practical Restoration Handbook

Health & Safety - Section 3
Construction Design and Management Regulations (1994)

by

Dave Carnell and Mike Palmer

Please note that, for convenience, the Practical Restoration Handbook "Health & Safety" chapter is split into 4 sections:

1. Site Aspects
2. Personal Safety and Insurance
3. Construction Design and Management Regulations
4. Control of Substances Hazardous to Health

Although these sections are primarily separate there are subjects which overlap and so all four sections must be considered as one chapter. It is essential that all four sections are read together to get an adequate understanding of the Health and Safety requirements for waterway restoration.

INTRODUCTION

1. INTRODUCTION

1.1 The CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 1994 (CDMR) were introduced in 1994 to implement the design and management aspects of the European Community Directive on Temporary or Mobile Construction Worksites (92/57/EEC). Unlike other health and safety legislation, CDMR imposes duties, not on employers per se, but on clients (those for whom construction work is being done) designers (including architects, quantity surveyors, etc.) and contractors. CDMR places responsibilities on other new duty holders – the principal contractor and planning supervisor (who oversee the health and safety arrangements during the design and planning phase of a project).

1.2 The objective of CDMR is to reduce the high accident rate in the construction industry by making those involved with construction projects consider health and safety issues as a fundamental part of designing a new project. This should be not only during constructioon, but throughout the whole life of a building or structure so that it is easy and safety to maintain and modify, and at the end of it's lifetime, demolish. CDMR requires the creation of a health and safety plan (for construction) and, so that future builders and architects know what they are dealing with, a health and safety file (for future construction works).

1.3 This section of PRH "Health and Safety" is intended to give volunteers (whether project planners or ordinary volunteers) an insight into the CDM legislation and the new responsibilities placed upon both them and others to plan, co-ordinate and manage health and safety throughout ALL the stages of a construction project.

1.4 As to whether your project falls under CDM regulations; only three people can decide this: the owner of the site, the officer of the local Health and Safety Executive or yourself. The authors would like to suggest that it will be least painless if you decide to comply before anyone else does.

1.5 The legislation does NOT make specific reference to volunteers, however unlike previous Health and Safety legislation it does not refer to paid workers (thus excluding volunteers) but simply considers everyone (workers [paid or unpaid] and public) that the responsible party has a liability for. It is, therefore, generally taken that volunteers do fall under at least some of the legislation if not all.

1.6 Responsibility for enforcing CDM is taken by the Health and Safety Executive (HSE) who have wide ranging powers to enter any site and inspect the site and associated documentation. Although not common, prosecutions can be severe, ranging from fines to imprisonment. HSE have always taken a keen interest in volunteer working - you have been warned!

1.7 At first glance CDM seems to be a long series of confusing, long winded definitions (often accompanied by confusing diagrams) and it must be admitted that unscrupulous “consultants” have profited by this confusion and incompetent managers have also used it as an excuse to put off or delay work.

1.8 However it will hopefully be seen that very little in the CDM legislation is new and what is new seems to help us. For a good organiser safety planning has always been an integral part of the planning of the project. He would have thought about such things as “will the dredger clear the electricity cables?” “Is the local casualty department open on a Sunday?” “Who do I ring if the dredger does bring down the power line?” The only difference is that instead of it being written down in his notebook and kept in his pocket, the notebook is now called the Health and Safety Plan and is kept in the site hut. This has obvious advantages if the powerline lands on the organiser. Similarly the dredger driver no longer has to think

"Who (if anyone) has checked if my dredger will clear the power line?" He now knows who is responsible, where the actual measurements are written down and what to do if anything changes.

1.9 As will be seen in section 7 it is possible to attempt to evade CDM requirements, however it is the authors opinion (and the policy of the Waterway Recovery Group [WRG]), that in the interests of the restoration movement as a whole it is considered "best practice" to adopt the recommendations of CDM.

1.10 The WRG Board firmly believes that following the spirit of the Health and Safety at Work Act for so many years has directly contributed to the excellent Health and Safety record that WRG holds. It is believed that CDM can further improve this situation.

1.11 This chapter is written for volunteers working on any waterway in the UK but it is worth noting that WRG and British Waterways (BW) have a joint booklet entitled "Volunteers Working Safely" that outlines what BW expect from volunteers wishing to work on their canals and what the volunteers can expect from BW. It is an excellent starting point for discussions with BW and is available from BW Regional Offices and IWA Head Office.

2. DEFINITIONS

2.0 The scope of CDM is based on the old definitions of whether a project was "notifiable" to HSE (this was basically defined as any project greater than 30 days in duration or more than 500 person days in duration).

2.1 Any previously notifiable project falls under CDM. In addition CDM applies to any work that includes demolition, regardless of the length of time or the number of workers. Finally, even if a project is not notifiable and involves no demolition then the design aspects of the work are still subject to CDM.

2.2 It is true, therefore, that by breaking down a restoration project into smaller and smaller jobs it could be possible to "wriggle" out of CDM for some parts of your project. This approach is to be avoided as the "overview" gained by considering the project as a whole is lost and risks that fall between specific jobs are not identified.

2.3 In addition the Health and Safety Executive (HSE) have made it clear that they will take a very poor view of anyone who tries to evade CDM by this technique. The widely held view is that it is only a matter of time before someone is prosecuted for just this.

2.4 British Waterways have also stated that it is their practice to consider all works as subject to CDM and they expect volunteer groups working on their waterways to do so too.

2.5 It is the case, however, that some aspects of the volunteers work are not covered by CDM. Straightforward hedge trimming, bank mowing or other such agricultural maintenance work is exempt. However, seeing as a full CDM assessment would not cover more than a page of A4, nor take much more than 10 minutes and is an excellent training exercise for people interested in safety legislation why not do one anyway? And when you hear someone say "Oh, I never knew a power cable ran through that hedge, I'll look out for that" you'll feel suitably smug, won't you?

3. COMPETENCE

3.1 This is undoubtedly the most common sticking point in the Health and Safety arena. The application of the word competent seems to most people to be entirely subjective. And to some extent this is true, however, it is a workable system. Although some areas do have situations where competence is clearly demonstrable – such as only a qualified civil engineer could design a highway bridge - there are many areas where there are no tests, exams or certificates – who is safe to set up a barrow run for concrete pour?

3.2 Where a straight definition or measure of competence is not given then an assessment must be made on whether the officer concerned is experienced enough (and has the resources) to complete the job. An alternative way of looking at this is that it is down to the Principal Contractor to prove his competence. This proof of competence does not necessarily take the form of a certificate, but may be just sufficient experience in the area concerned.

3.3 This is, of course, a generalisation and there are many areas where competence is carefully and objectively measured, however for some areas of Health and Safety competence IS a subjective matter.

3.4 One essential element of competence is that the person concerned has sufficient resources (such as skills, finance and especially time) to carry out their duties.

4. CDM OFFICERS AND THEIR DUTIES

4.0 The duties of CDM officers given here are taken from the HSE leaflet "CDM Regulations – how the regulations affect you" (ref. C400).

4.1 **The Client:** This is the owner of the waterway i.e. the navigation authority, landowner or Local Authority. their duties are:

- to appoint a competent Planning Supervisor and provide him with any information relevant to the Health and Safety of the project
- to appoint a competent Principal Contractor
- be satisfied that the Designers and Contractors appointed by the Planning Supervisors are competent
- to ensure construction work does not start until the Principal Contractor has prepared a satisfactory Health and Safety Plan
- to ensure the Health and Safety File is made available for inspection and use after the project is completed.

Where the client does not have the resources to fulfill these roles he may appoint an Agent.

4.2 **The Planning Supervisor:** Who has overall responsibility for co-ordinating the Health and Safety aspects of the design phase and for the early stages of the Health and Safety Planning and their dutes are to ensure that:

- designers comply with their duties (in particular the avoidance and reduction of risk)
- designers co-operate with each other

- a pre-tender Health and Safety Plan is prepared
- the HSE is notified of the project (this is normally done using Form F10rev)
- the Health and Safety File is completed and handed over to the Client

4.3 **The Designer:** Should ensure that the structures are designed to avoid risk or where this is not possible minimise risks to Health and Safety. This applies both whilst works are undertaken and after completion, including maintenance. Where risks cannot be avoided adequate information must be provided. Design includes the drawings, bills of quantities and written specifications for a project. They have a duty to:

- alert clients to their duties
- consider during the design phase the risks that may arise to those constructing and maintaining the structure
- design those risks out or
- minimise these risks if unavoidable
- ensure that the design communicates this Health and Safety information
- pass on this Health and Safety information to the Planning Supervisor
- co-operate with the Planning Supervisor and any other designers working on associated projects

4.4 **The Principle Contractor:** This is the main body working on the project, they should take account of Health and Safety issues when preparing and presenting tenders or similar documents. The Principal Contractor has a duty to:

- take over, develop and implement the Health and Safety Plan
- arrange for competent and adequately resourced contractors to carry out the work where it is sub-contracted
- co-ordinate the activities of ALL Contractors to ensure they comply with Health and Safety Law (such as Health & Safety at Work Act, Control of Substances Hazardous to Health etc.) and any site rules set out by the Health and Safety Plan
- ensure that contractors have information about risks on site
- obtain from contractors the main findings of their risk assessments and details of how they intend to carry out high risk operations
- check on the provision of information and training for workers and for consulting with them on Health and Safety
- monitor Health and Safety performance
- make sure only authorised people are allowed on site
- display the notification of the project to the HSE
- pass information to the Planning Supervisor for the Health and Safety File

4.5 **Contractors:** have duties to play their part in the successful management of Health and Safety during construction work. They should co-operate with the Principal Contractor and ensure that they:

- provide information for the Health and Safety Plan about risks to health and safety arising from their work and the steps they will take to control and manage the risks

- manage their work so that they comply with rules in the Health and Safety Plan and directions from the Principal Contractor
- provide information for the Health and Safety File, and about injuries, dangerous occurrences and ill health
- provide information to their workers

5. DUTIES OF THE WORKER

5.0 Under CDM all workers, whether paid or voluntary, benefit by being better informed and more able to play an active part in health and safety.

Workers are:

- required to work in accordance with the Health and Safety Plan
- entitled to free access to the Health and Safety Plan during the construction phase
- entitled to any free training required by the Health and Safety Plan
- able to express their views about health and safety to the Principal Contractor
- required to communicate any Health and Safety information back to the Principal Contractor as outlined in the Health and Safety Plan

6. HEALTH AND SAFETY PLAN

6.0 **A**s mentioned previously CDM attempts to ensure that effective (two way!) communication takes place to minimise risks to both workers and the public. The Health and Safety Plan is the main vehicle for this communication.

6.1 In simple terms a preliminary draft comprising all the relevant Health and Safety information is drawn up by the Planning Supervisor. (In the commercial world this is known as the "Pre-tender Health and Safety Plan"). This will then be developed by the Principle Contractor based on the works intended to be carried out and the methods used. This continues until the Planning Supervisor is satisfied that it represents a satisfactory plan – this is the initial "Health and Safety Plan for the construction phase". From this it will be possible to start the project.

6.2 Thus the Pre-tender Health and Safety Plan should include:

- A general description of the work
- Details of timing within the project
- Details of known risks to workers (e.g. buried cables)
- What information is required to demonstrate a Principle Contractors competence, and adequacy of resources
- Any other information that the Designer or Planning Supervisor considers necessary for the preparation of a Health and Safety Plan for the construction phase

- Expected welfare provision for workers

6.3 The Health and Safety Plan for the construction phase should include:

- A developed version of the Pre-tender Plan taking into account all issues raised. Risks identified either by the Pre-tender Plan or the further planning of the project by the Principle Contractor must be considered fully and minimised
- Arrangements for ensuring the Health and Safety of ALL who may be affected by the works
- Arrangements for the management of Health and Safety and the monitoring of compliance with Health and Safety Law
- Arrangements for the effective communication of any Health and Safety developments.
- Information about welfare arrangements.

6.4 Thus it can be seen that at the point of starting a project all the information is available for workers and clearly laid out guidelines exist for what to do once a problem is encountered. Any developments that pertain to Health and Safety must be added to the Plan in the manner described in the Plan. It is essential that deviations from the Health and Safety Plan are fully communicated to all parties responsible for developing the Plan (Designer, Planning Supervisor, Principle Contractor).

6.5 The Planning Supervisor is responsible for seeing that the initial Health and Safety Plan is developed sufficiently for works to start. The Principal Contractor then has the responsibility to develop the Health and Safety Plan and keep it up to date once works are underway.

6.6 Generally it is acceptable for a Health and Safety Plan to make reference to standard texts or guidelines providing that these guidelines are approved by the Planning Supervisor and available alongside the Health and Safety Plan. This is a common technique and can be seen in the Health and Safety Plan examples given in Appendix 2.

6.7 It is also worth noting that an initial Health and Safety Plan does not necessarily have to have all the answers but it is essential that all the right questions have been asked (and the source of the answer has been identified). This does not mean that “make it up as we go along” is an acceptable entry in the initial Health and Safety Plan but “exact method of concrete placement to be determined once dewatering has taken place (to be assessed by competent person following WRG “Concreting Guidelines”) may well be.

7. HEALTH AND SAFETY FILE

7.0 This is the ultimate evolution of the Health and Safety Plan. It is the record of information for the Client/end user, which tells those responsible for the structure in the future of the risks that have to be managed during maintenance, repair or renovation. Any hazards real or potential must be noted. It is the Planning Supervisor who has to ensure that it is prepared as the project progresses and is given to the Client when the project is completed. The Client has to make it available to those who will work on any future design, building, maintenance or demolition of the structure.

8. ASSESSMENT TECHNIQUES

8.0 In addition there are three other terms that frequently arise during development of the Health and Safety Plan; these are Method Statement, Risk Assessment and Safe System of Working.

8.1 **Method Statement:** this is the usual starting point for developing the Health and Safety Plan. It is an account of the intended jobs and the techniques that will be used. It is most often requested of the Principal Contractor by the Planning Supervisor but it can be used by anyone. It will probably not contain too much detail but will give the Planning Supervisor a good idea as to whether he is happy with the techniques that the Prcinipal Contractor is suggesting. "Demolition of wing wall will be from the top down from scaffolding using electric hammers with waste material disposed of off site. Public access prohibited. Normal PPE." might be a typical entry. It sets out the tasks necessary, how they will be completed and any guidelines that will be followed. Once the Planning Supervisor is happy with this it will progress onto the Risk Assessment.

8.2 **Risk Assessment:** this is exactly what it says it is. It is a step by step examination of the project with the specific intention of highlighting risks that may occur during the project. It should highlight both long term risks (wall will require bracing for duration of project) and short term risks (care to be taken when excavator tracks past trench). Both WRG and BW support the judgemental approach to Health and Safety planning, to take full advantage of their workers knowledge and experience, rather than numerical or other fancy approaches that appear (spuriously) to be more scientific. Please note that the idea is not simply to highlight risks and then take precautions, ideally the risks are "designed out" altogether and appropriate precautions only taken if the risks are unavoidable. From the Risk Assessment the Safe System of Work is developed.

8.3 **Safe System of Work:** this is the logical result of a Risk Assessment and sets down the way that tasks are to be performed so risks are minimised. It will include, for example, comments on lifting and handling, control of access, evacuation and emergency procedures, material storage, protective clothing and equipment, etc.

9. HOW DO THESE ROLES APPLY TO VOLUNTEERS?

9.0 This is not as fixed as you would expect. Hopefully it can be seen that the definitions given in Section 4 fit reasonably well with the existing roles of canal owner/working party organiser/canal society/visiting group/canal camp/etc. The notes that follow are a generalisation of the roles, it must be stressed that these are not set in stone and with the mutual agreement of all parties they could be changed.

9.1 One question often asked is whether the role of a CDM officer is taken on by an individual or by a group. There is no fixed answer to this as to some extent it is dependent on the group involved i.e. does it exist legally. One thing is certain, if a group is accepted rather than any individual then a named representative will be required. An example of this would be if a Canal Group was the Principal Contractor then a blackboard on the site hut door with "today's leader is....." would be required.

9.2 When assessing the appointment of CDM Officers then the keyword is competence, and whether it is demonstrable in such areas as Health and Safety law, risk assessment, designing Safe Systems of Work. It is also necessary to ensure that an officer has the sufficient resources (such as skills, finance and especially time) to carry out their duties.

9.3 Assuming such competence is demonstrable there is no reasonw hy a volunteer or a volunteer group could not occupy any of the roles of CDM officer (somewhere there must be a Canal society that occupies all five roles!). The local society or resident group would most likely take on the role of Principal Contractor and would have the job of developing the Health and Safety Plan by filling in all the details. Most importantly of all they must continue to do so as the work continues, for example filling in the gaps where the plan says "exact method of safe reconstruction to be determined after demolition". Remember that any modifications or additions to the Health and Safety plan should be communicated to and agreed by all parties.

9.4 Any visiting group such as a WRG weekend group or Canal camp would normally have the position of Contractor.

9.5 An example of a deviation from this standard arrangement would be a Canal Camp where a bridge owned by a local authority was to be replaced with a standard design, the local canal society had not worked on the bridge and it was separate from their usual sites. Given that the project can be viewed as a standalone job it may well be a sensible arrangement for the LA to take on the duties of Client and Designer and the Camp Leader (if competent and willing) to take on the tasks of Planning Supervisor and Principal Contractor. However, if the bridge was over a lock that was under restoration then it would be sensible for the project to come inside the existing Health and Safety management structure.

9.6 The exact breakdown of responsibilities is to be agreed by all parties and each officer and their contact details should be named in the Health and Safety Plan.

10. INSPECTIONS, REGISTERS AND RECORDS

10.1 It is often recommended as part of a Health and Safety Plan that items are inspected on a regular basis. Indeed it is often the case that there is a legal requirement to do so for such items as scaffolding, etc. There are two issues that often cause confusion; who is acceptable to inspect and how do they register their inspection?

10.2 Not surprisingly the issue of competence raises itself and again whilst there are many areas where competence is clearly defined (such as a scaffolders certificate) it may also be acceptable for someone with suitable experience to be considered competent within defined limits. People competent to inspect are listed in a Register and any inspections they carry out are listed in a Record. Although the case is different for each area (abrasive wheels, lifting equipment, welfare, etc.) the situation may best be illustrated by an example of how a volunteer site may comply with the spirit of the law.

10.3 Consider a reasonably complex scaffolding to gain access to replace a line of coping stones. The scaffolding should be designed by someone competent (this will be proven by a certificate), and installed by a competent installer (again certificated), who will sign it off as installed "as per design" in the Record if Inspections. Before leaving site he will also instruct volunteers with suitable experience of scaffolding on any important points about this scaffold and what frequency it should be inspected. These volunteers would be named in the Register of Inspectors. They would carry out inspections up to their level of competence (e.g. daily inspections or after a change of weather). These inspections would be kept in a Record of Inspections. But should the scaffold be struck by a falling coping stone they would not be competent to assess the safety of the scaffolding and the designer or installer would need to be called in to re-inspect.

10.4 Commonly used records are listed in Appendix 1. It is not absolutely necessary to use proper HMSO records (the HSE would rather see a ruled piece of A4 than nothing at all) but seeing as they cost only a few pence from HMSO it makes sense to use the correct forms. There is also further helpful guidance on the inside of each document. It is a requirement to keep these documents for at least 2 years after finishing the project.

10.5 It is strongly recommended that local societies compile a register of the competencies of their individual volunteers, even though this may be augmented for individual inspection regimes.

11. CONCLUSION

11.0. CDM promises great benefits but it will only work if all parties co-operate and communicate. Not only should it create a safer environment for workers and public alike but by taking an overview other benefits will accrue. CDM should result in a smoother running project with more questions answered before site work starts, better financial planning, lower hire costs, more efficient use of materials, less wastage, better time management, etc.

11.1 Volunteers have no reward but the satisfaction of sleeping well in their beds at night, they deserve adequate resources allocated to Health and Safety matters to ensure it is their bed they sleep soundly in and not the local hospital.

12. FURTHER READING AND ADDRESSES

"Volunteers Working Safely"
British Waterways
Willow Grange
Church Road
Watford
WD1 3QA

"CDM Regulations – How the Regulations affect you!"
"Construction Site Health and Safety Checklist (Construction Sheet 17)" - highly recommended
Health and Safety Executive
HSE Books
PO Box 1999
Sudbury
Suffolk
CO10 6FS

APPENDIX 1 – LIST OF TEXTS AND PUBLICATIONS REFERENCE IN THIS CHAPTER

Note that texts are listed under the section of the Chapter in which they are primarily referenced but may also be referred to in other sections. It is recommended that these texts are obtained as they will assist greatly with Health and Safety planning.

Section 1 – Site Aspects

Code	Title	Available from
	HSE Construction Summary Sheets	
SS2(rev)	Safe Use of Ladders	HSE
SS3 (rev)	General Access Scaffolds	HSE
SS6	Portable Electric Tools and Equipment	HSE
SS8 (rev)	Safety in Excavations	HSE
SS11(rev)	Safe Use of Propane and other LPG cylinders	HSE
SS12	Flame Cutting and Welding with Compressed Gases	HSE
SS16	The Control of Substances Hazardous to Health	HSE
SS17	Construction Site Health and Safety Checklist	HSE
SS26	Cement	HSE
SS28-35	Your Body at Risk: Are you Properly Protected?	HSE
SS50	Personal Protective Equipment: Safety Helmets	HSE
na	Noise in Construction	HSE
na	Construction (Working Places) Regulations 1966	HMSO
na	Carriage of Dangerous Substances in Packages Regulation	HMSO
na	Health and Safety at Work Act	HMSO

Section 2 - Personal Safety and Insurance

Code	Title	Available from
green book	Volunteers' Health and Safety Guide	WRG
B1510	Accident Record Book	HSE
IND(G) 84L	Leptospirosis - are you at risk?	HSE
SS18	Provision of Welfare at Fixed Construction Sites	HSE
SS46	Provision of Welfare at Transient Construction Sites	HSE
SS51	Construction Fire Safety	HSE
na	Insurance Guidelines	IWA

Section 3 - Construction Design and Management Regulations

Code	Title	Available from
na	Construction, Design and Management Regulations 1994	HMSO
F10	Notification of project to HSE	HSE
C400	CDM Regulations - How the Regulations affect you!	HSE
SS17	Construction Site Health and Safety Checklist	HSE
SS40	The Role of the Planning Supervisor	HSE
SS44	The Health and Safety File	HSE
	Guide to the Provision and Use of Work Equipment Regulations 1998	HSE
	Guide to the Lifting Operations and Lifting Equipment Regulations 1998	HSE
F91/CE	Lifting Appliances Record	HMSO
F91/A	Scaffolding Record	HMSO
F91/J	Lifting Gear Record	HMSO
F2202	Welfare Arrangements Record	HMSO
na	Volunteers Working Safely	BW

Section 4 - Control of Substances Hazardous to Health

Code	Title	Available from
na	Control of Substances Hazardous to Health 1988 & 1994	HMSO
na	Health and Safety at Work Act, 1974, 1992	HMSO
na	Factories Act 1961 Revised	HMSO
na	Health and Safety Information, Employees Regulations 1989	HMSO
na	Highly Flammable Liquids and Liquified	HMSO
	Petroleum Gases Regulations 1972	
na	Approved Code of Practice Control of Substances Hazardous to Health 1994 (ACOPS) **Health and Safety Executive Guidance Notes**	HMSO
	Environmental Hygiene Series:	
EH17	Petroleum based adhesives in Building Operations	HSE
EH8	Arsenic: toxic hazards and precautions	HSE
EH9	Spraying of highly flammable liquids	HSE
EH16	Isocyanates: toxic hazards and precautions	HSE
EH22	Ventilation of Buildings	HSE
EH26	Occupational Skin Diseases: Health and Safety Precautions	HSE
EH40	Occupational Exposure Limits (Revised Annually)	HSE
EH42	Monitoring Strategies for Toxic Substances	HSE
EH43	Carbon Monoxide	HSE
EH44	Dust in the Workplace: general principles of protection	HSE
EH46	Exposure to Mineral Wools	HSE
	General Series:	
GS5	Entry into Confined Spaces	HSE
GS29/4/	Health and Safety in Demolition Work. Part 4	HSE

GS46	In Situ Timber Treatment using Timber Preservatives; health and environmental precautions	
	Medical Series:	
MS8	Isocayanates; medical surveillance	HSE
MS15	Welding	HSE
	Hazard Information Sheets	
No. 1	Cements 1985	HSE
No. 5	Solvents 1988	HSE
No. 7	Skin Hazards 1988	HSE
No. 8	Pesticides 1989	HSE
	Construction Summary Sheets	
SS15	Confined Spaces 1988	HSE
SS24	Chemical Cleaners	HSE
SS26	Cement	HSE
SS27	Solvents	HSE
SS36	Silica	HSE
	Respiratory Protective Equipment	
BS4275	Recommendations for the selection, use and maintenance of Respiratory Protective Equipment 1974	HSE
	Respiratory Protective Equipment (RPE): Legislative Requirements and lists of HSE approved standards and type approved equipment 1989	HSE
	Health Safety Leaflets	
	Introducing COSHH. A brief guide for all employers to the new requirements for controlling hazardous substances in the workplace	
	Introducing Assessment: a simplified guide for employers	
	Managing Health and Safety in Construction	
	Part 1: Principals and Applications to main contractor/visiting group projects. HMSO 1988	
	Part 2: Management Contracting HMSO 1988	
	Hazard and Risks Explained	
	Control of Hardwood Dusts 1987	
	Health Hazards to Painters 1989	
	Miscellaneous Documents	
	A Guide to Safe Use of Chemicals in Construction	CIRIA
	Construction Safety Manual : Section 25	BEC/BAS
	Development of Contaminated Land; Dept. Of Environment Circular 21/87	DoETR
	COSHH In Construction : A BEC Guide	BEC
L101	Safe Work in Confined Spaces	HSE

Addresses for these texts

Health and Safety Executive
HSE Books
PO Box 1999
Sudbury
Suffolk
CO10 6FS

HMSO
Any Local HMSO bookshop

Ciria
6 Storeys Gate
Westminster
London,
SW1P 3AU
0171 222 8891
www.ciria.org.uk

BEC Publications
Federation House
2309 Coventry Road
Sheldon
Birmingham
B26 3PL
0121 742 0824

Inland Waterways Association
Waterway Recovery Group Ltd
PO Box 114
Rickmansworth
WD3 1LT
01923 711114

APPENDIX 2 – EXAMPLES OF HEALTH AND SAFETY PLANS

Due to the many and diverse tasks encountered by restoration volunteers it can be expected that they will come across a great number of diverse presentations and layouts of Health and Safety Plans.

Three examples of WRG plans are enclosed: one having an alphabeitcal index, the other two numerical.

Both follow a logical step by step approach for the completion of the task with:

- General Safety Considerations
- Listing of relevant legislation (COSHH, Health and Safety at Work Act, etc.)
- Specific Site Considerations
- Telephone numbers of the other key parties involved
- Tasks to be carried out and their individual safety requirements

None of these examples are held up as the ideal Health and Safety Plan. However they satisfied the Planning Supervisor concerned and are regarded as a good way of presenting the relevant information for each particular job. Those responsible for developing Health and Safety Plans should beware of just copying previous Health and Safety plans, it is bad practice (there are bound to be differences between projects) and if you are to reap benefits from CDM it is necessary to examine each project separately. It is for this reason that WRG has not produced a standard pro forma Health and Safety Plan.

It can be seen that several of the Health and Safety Plans refer to standard guidelines and references to avoid the need to repeat details and make the presentation of the Plan easier to follow. The text referred to in these examples is the old WRG Large Health and Safety Guide. This has now been replaced by the Practical Restoration Handbook Sections 1-4 i.e. this guide!

CONSTRUCTION HEALTH AND SAFETY PLAN

Job:	Northsyke Footbridge
	(Savick Brook, Preston)
LCC ref:	9348
WRG ref:	CC1196, CC1396
Site leader:	Mike Palmer (12th-20th July)
	Martin Johnson (21st-28th July)
Assistant:	Matthew Taylor

Northsykes Footbridge Construction

General Safety Considerations

The following Safety Assessment has been prepared in conjunction with the WRG Health and Safety Guide and should be read alongside it.

All work is to follow the guidance of the WRG Health and Safety Guide.

Volunteers will only be allowed to work on site once they have received a Safety Talk from the Site Leader.

They must read the WRG "volunteers guide to safety" and sign to say they have done so.

The Health and Safety File is to remain on site at all stages of the work and is then to be passed to LCC.

Local emergency services information is to be included in the Health and Safety File.

Site to be designated a "hard hat area" for the duration of works.

WRG Driver Authorisation scheme will operate at all times for all classes of plant on the site.

First aid provision on site will include:

- one HSE First Aid Kit for up to 50 employees
- additional eyewash facilities (2 x 500ml bottles minimum)
- welfare kit

Each vehicle will carry a First Aid kit.

Each volunteer will be issued with

- a safety helmet to BS 5240

In addition, where the job dictates, the volunteer will be issued with:

- eye protection to BS2092
- hearing protection to BS5108
- disposable nuisance dustmasks to EN149
- suitable gloves

Site Specific Safety Considerations

It is assumed that LCC will have completed the installation of the pier bases.

Stated weight of a single main beam is 0.75T and completed bridge is 2.4T.

LCC to supply any required safety signs.

LCC to supply the design for the temporary scaffolding for access to the old bridge.

CDM

- LCC to notify HSE using Form F10.
- LCC to supply all details of known or suspected hazards for the Health and Safety File.
- LCC are, for the purposes of CDM, considered to be Client, Designer and Planning supervisor.
- WRG are, for the purposes of CDM, considered to be the Principal contractor.
- The WRG contact before the work is Mike Palmer (0121 472 2882).
- The WRG site leader is Mike Palmer (13th-20th July) then Martin Johnson (21st-28th July).

Emergency Procedures

- Location of the nearest 24 hour Accident and Emergency Hospital is to be stored in the Site Health and Safety File and in all WRG vehicles.
- Location of nearest public phone is to be stored in the Site Health and Safety File and in all WRG vehicles.
- Site mobile phone is to be available on site at all times (0850 422157).
- A sign is to be placed where the footpath meets the road for emergency vehicles to locate the site entrance, if access is not permitted through the sports ground.
- One emergency WRG vehicle is to remain on site at all times.
- On site there will always be one nominated individual (usually the Site Leader) to take charge in the event of an emergency.

Pedestrians

- The right of way across the Savick Brook at this point must be maintained at all times (except in an emergency).
- Temporary fencing (orange mesh and lamp-irons) is to be used to prevent access to any incomplete works or unsafe areas. Due consideration must be given to trespassers including vandals, children and golfers looking for lost balls. LCC to supply this fencing. (Orange mesh and lamp-irons).
- Consideration will need to be given to loss of installed fencing overnight by vandals.

COSHH

- All relevant COSHH Data sheets will be available in the Site Health and Safety file.

Liaison

- LCC contact is Paul Medlam (01772 264479)
- A contact is requested from LCC for the NRA for use in emergency
- A contact is requested from LCC for the Golf Club
- A contact is requested from LCC for the Sports Ground

TASK	Refer to section In Guide:	SAFETY
I. Install safety screens, fencing and signs. Liaise with Golf Club	C	Consider all pedestrian access routes (inc. trespassers). Ensure no unauthorised access to incomplete works. This to be checked/modified on an "as required" basis.
II. Agree positions of supply stores (including fuel) Liaise with sports group if appropriate with regard to access and storage.	C/D/E	Ensure no materials are stacked where safe access for loading/unloading is compromised. Public access to stores is not permitted. Fuel stores to be safe, lockable and marked.
III. Check safe access routes for skid steer loader.	K	Mark off any unsafe areas. Ensure all operators are aware of them.
IV. Construct bridge piers:		
A. Assemble steelwork and install.	P/V	Care to be taken when preparing steelwork – no sharp edges. Eye protection to be worn.
B. Build stone piers backfilling with concrete on a section by section basis.	E/G/K	Ensure lifting is non strenuous and safe. Ensure safe wheel barrow route and tipping area. Ensure adequate eye and skin protection.
C. Construct shuttering for pier tops	L	
D. Pour pier tops	E/G/K	Ensure safe tipping area. Ensure adequate eye and skin protection.
V. Assemble bridge:		
A. Clear space by golf course for assembly bridge.	C	Consider pedestrian movements.
B. Escort bridge onto site across golf course	K	Care to be taken with extreme wide/long loads. Ensure golfers are aware and flying golf balls are not a problem.
C. Assemble bridge.	G/L/P	
D. Escort crane across golf course. Liaise with Golf Club.	K	Seek crane operators advice. Ensure golfers are aware and flying golf balls are not a problem.
E. Lift bridge onto piers.	M	Seek crane operators advice on slinging and loading. Appoint banksman if required. Ensure only essential staff are working in load area.
F. Fix bridge down.	I/P	Care when working from/on incomplete structure.
G. Lay bases for steps	E/G/K	Ensure safe tipping area. Ensure adequate eye and skin protection.
H. Assemble handrails structure	I/L	Care when working from/on incomplete

I. Assemble steps	I/L	
J. Commission new bridge	n/a	To be approved by LCC?
VI. Demolish old bridge:		
A. Position acrow supports under old bridge	n/a	Acrows to be checked daily for creepage. Bases to be checked for river erosion.
B. Cut pedestrian barriers off old bridge for wheel barrow access	C/V	No sharp edges to be left.
C. Assemble scaffolding	I	Scaffolding to be to LCC design and be inspected daily. Care when working in and above water course.
D. Demolish old bridge	I/M/P	Only to occur once new bridge has been commissioned by LCC. Care when working from/on incomplete structure. Care when working in and above water course.
E. Dispose of old bridge	E	Care with dangerous waste. To be disposed of via skip specifically for this purpose.
F. Remove scaffolding	I	Care when working from/on incomplete structure. Care when working in and above water course.
VII. Clear site and make safe.	C	Ensure no dangerous materials left on site and all temporary works are removed.

London Canal Museum
14th - 21st February 1998

Health & Safety Plan

(Abridged for use as an example for Health and Safety Handbook)

i) Setting up the accommodation (first floor)

ii) Setting up the worksite (ground floor)

iii) Safe system of work

iv) Emergency procedures

v) Daily checklist

vi) Volunteers health & safety introductory talk

vii) Visitors procedure

i) **Setting up the accommodation (first floor)**

1. Clearance of museum displays to the satisfaction of Canal Museum Trust.
2. Catering cooker to be located on first floor (via the horse ramp) beneath a set of opening windows, a fire extinguisher shall also be provided.
3. Kitchen to contain:
   - Electric hob
   - Gas stove
   - Deep fat fryer
   - Electric water boiler
   - Fire extinguisher & fire blanket
4. Utility room (education room) to contain:
   - Electric fridge
   - Catering kit & food
   - First aid kit (catering)

ii) **Setting up the worksite (ground floor)**

Refer to the accompanying sketch ‘safe system of work’.

1. Clearance of museum displays to the satisfaction of Canal Museum Trust.
2. Open museum doors to encourage thru-ventilation.
3. Position skips during delivery away from entrance/exits to other buildings.
4. Locate skip ramps away from entrance/exits to other buildings and delivery areas. Ensure they are fixed to skip side and angled correctly. Install a timber end stop at top of ramp.
5. Establish hard hat area inside museum to include ground floor and ice pits.
6. Test atmosphere in ice pits.
7. Fix 110v festoon lighting throughout ice pits 1&2, and test halogen lighting. Ensure lighting is so placed to minimise shadows where possible.
8. Remove two barriers from sides of hatch, replace with stop boards at floor level and temporary hand rails at waist height fixed to remaining barriers.
9. Fix access/escape ladders at correct angle and projection above hatch opening. Ensure ladders are firmly footed at base and fixed at top.
10. Test submersible pump and pump sump dry.
11. Install acrow props/bracing to connecting passage between ice pits 1 & 2.
12. Sheet fully over sump hole and hole located in connecting passage.
13. Erect hoist frame, electric hoists and cables above hatch. Conduct test lowerings of empty barrows to establish ‘hoist area’ at pit level.
14. Re-erect two barriers at pit level around ‘hoist area’ and stabilise using ties.
15. Ground floor office to contain:
    - Washing facilities

- Electric water boiler/tea making facilities
- First aid kit (site)
- Emergency telephone

16. Establish health and safety notices and visitor book outside ground floor office.

iii) **Safe system of work**

Refer to the accompanying sketch 'safe system of work' (not included for brevity).

General Practices

- Never enter ice pits unless instructed to do so by an appointed leader
- Atmospheric testing to be carried out by a competent person every hour and when suspect materials are discovered
- You must wear a hard hat, safety boots, and gloves when working in the ice pits
- Never work alone
- Keep equipment clean, especially ladders and skip ramps
- Retire and report any broken/faulty tools and equipment
- Beware of moving vehicles when working in New Wharf Road
- Only one person at a time allowed on ladders and ramps (except escape ladder)
- Only use 'escape ladder' during emergencies
- Tea and meal breaks to be taken in ground floor office or first floor accommodation
- Temporary handrails to be fitted around hatch openings when work ceases

Digging Practices

- Do not work too closely to others
- Do not enter 'hoist area' unless instructed to do so by an appointed leader
- Do not fill skips and barrows above level of sides
- Observe 'one way system' for barrows from pit level to skips
- Only take barrows up skip ramps if you feel confident to do so
- Work in a methodical pattern to avoid unnecessary holes (suggest working from a ring trench towards centre of pit)
- Maintain an even surface at foot of ladders
- Maintain sump pit at least 0.5m below pit level and avoid any build up of water
- Maintain gentle grade between pits 1 & 2, working in Ice pit No. 2 when instructed
- Maintain sheeting over all unattended pits and trenches
- If any suspected voids or hazardous materials are discovered, all unnecessary personnel to leave the pit and material placed in bags
- When instructed to work in 'hoist area' only do so when hoist operations have been stopped and hoist operators made aware of your presence

Hoist Practices

- Hoists may only be operated by personnel appointed by the leader
- No leaning over hatch permitted at any time
- Only hoist operator and assistant allowed near hatch opening at all times
- Only banksmen allowed to enter 'hoist area' and only to handle barrow chains

- No hoist operation allowed without a signal between banksmen and hoist operator, and the hoist operator checking the 'hoist area' is clear first
- Hoists to be swung away from hatch and switched off when personnel digging in hoist area

iv) **Emergency Procedures**

Whilst thorough plans have been made to prevent accidents, it is essential that anyone on the site is familiar with the actions to be taken in an emergency if one were to happen.

1. Evacuation of the Ice Wells

Evacuation of the ice wells will be required in the event of a real or potential danger to people in them. The signal to evacuate will be one of:

- Sounding of the gas alarm
- Whistle sounding with shouts of "evacuate"
- Calling out "evacuate"

The need to evacuate could arise from:

- Suspected gas, chemical, or high volume water ingress
- Dangerous conditions elsewhere in the Museum building (e.g. a fire)
- Discovery of something in the refuse which might pose a threat - evacuation pending investigation
- Some other situation where remaining in the wells would give rise to potential danger

a. If the signal to evacuate is given, everyone in the Wells should leave all tools behind (though not in a position where people following might fall over them) and walk briskly (do not run) to the ladders. Both ladders will be used - the one leading direct to the Museum gallery is to be preferred if both are free.

b. The person nearest the hoist operator should inform the latter by shouting. The hoist operator will call the camp leader or his deputy.

c. Everyone leaving must note who is following them and observe that they follow all the way out of the wells. The last person to leave the front well (the one without the opening above) should, so far as possible, check visually that nobody is behind him or her. This is essential to ensure that everyone leaves the wells or attention is immediately drawn to anyone who does not do so. If emergency evacuation has to take place in darkness, people are to hold hands and evacuate in a "chain" as far as the area under the floor opening.

d. After leaving the wells everyone who was in them is to assemble in the area near the main museum entrance and a roll call will be taken. Everyone will be expected to confirm that those working near them before the evacuation are present.

e. Re-entry into the wells is not allowed until the situation has been assessed by the camp leader or his deputy and the emergency declared over.

In the event of it being necessary to evacuate whilst a person is injured or trapped in the wells, the injured person is to be helped to the surface if the injuries so allow (e.g. twisted ankle) but in the event of a person

being trapped, the rescue will be performed by the fire service. (The camp leader or deputy will judge the circumstances and make decisions as required at the time).

2. Gas Detection

a. In the event of a gas alarm sounding, follow the emergency evacuation procedure.

b. The Camp Leader or deputy will not declare the emergency over until the atmosphere has been retested and found to be safe.

c. During the sounding of the gas alarm there must be no attempt to rescue anyone thought or known to be still in the well - if there is reason to suspect that someone is still in the well, the fire service must be called by dialling 999.

3. Electrical blackout

In the event of a failure of electricity supply so that there is no light in the wells, torches will be used to provide emergency lighting. Unless there is also an emergency requiring emergency evacuation, the emergency evacuation procedure will not be followed but instead everyone will leave the wells in a *slow and careful* manner using the torches. The person nearest the torches will use them to light the way for others to leave. Nobody will remain in the wells during a complete failure of the electric lighting.

4. Fire

The building does not have a fire alarm system. Emergency lighting to fire escape routes is provided. Whistles will be the alarm signal together with shouts of "Fire". In the event of discovery of a fire:

- Use whistles to wake or alert others, and call "Fire".
- Evacuate the building by the nearest exit. The rear fire exit leads to the side of the canal basin. The route from there to New Wharf Road is via Battlebridge Moorings and the exit in the corner of the basin to Wharfedale Road then back along the street. Close all doors and windows (where no delay will be caused) behind you. Do not stop to collect belongings. However, at night, pick up warm clothing, sleeping bag, etc. as immediately available without delaying your exit.
- Call the fire service by ringing 999 from the Museum's telephone or any available telephone.
- Assemble in New Wharf Road on the opposite side to the Museum for a roll-call (as per well evacuation)
- Do not re-enter until it has been declared safe to do so by the fire service or the camp leader or his deputy.

Small Fire

Small fires, e.g. in a waste paper pin, may be tackled using extinguishers which are located strategically around the building. Water extinguishers (which are coloured red all over) should not be used on electrical equipment or on cooking fires involving hot fat - a fire blanket or powder or gas fire extinguisher should be used on these. Fire can spread very quickly - if in any doubt, evacuate.

5. Injury

In the event of a serious injury, help must be summoned by using the whistles followed by shouting "injury". The nearest persons must:

a. Call the Camp Leader or deputy, and the first aider.

b. If the first aider feels it necessary Dial 999 using the phone in the ground floor office to call an ambulance (if the injured person is in the wells the fire service should also be called).

If the patient is in the wells, those who are not able to offer help should leave the wells. The first-aider will assess the injury and decide the appropriate measures to be taken. In general, if the patient is able to climb the ladder safely with assistance this will be done but where this is unsafe or not possible due to his or her condition, the fire service will be asked to lift the patient out of the well - the hoists will not be used except under direction of the fire service.

In some circumstances the first-aider may decide to take the patient to hospital by car or van rather than wait for an ambulance. The nearest hospital is:

University College Hospital
Accident & Emergency Department
Cecil Flemming House, Grafton Way

The map shows the location and route.

v) Daily Checklist

A competent person as appointed by the Planning Supervisor must ensure the following daily checks are made of the worksite before any personnel begin work:

- Check museum doors are opened
- Check atmospheric condition of ice pits is safe
- Note water level & use submersible pump to empty sump
- Check both lighting systems are operational
- Check condition of all ladders and ramps
- Check ice pits for new structural failure and note condition of existing
- Remove any temporary guardrails to hatch openings

vi) Volunteers Health & Safety Introductory Talk

Not included for brevity.

vii) Visitors Procedures

As a visitor you are required to read the following parts of the Health & Safety Plan, and sign the Health & Safety Declaration, before gaining entry to the designated worksite.

CONSTRUCTION HEALTH AND SAFETY PLAN

Job:	Leasowes Park Weir (Lapal Canal Halesowen)
WRG ref:	CC397
Site leader:	Mike Palmer (29th March - 5th April)

Leasowes Park Weir Refurbishment

General Safety Considerations

The following Safety Assessment has been prepared in conjunction with the WRG Health and Safety Guide and should be read alongside it.

All work is to follow the guidance of the WRG Health and Safety Guide.

Volunteers will only be allowed to work on site once they have received a Safety Talk from the Site Leader.

They must read the WRG "volunteers guide to safety" and sign to say they have done so.

The Health and Safety File is to remain on site at all stages of the work and is then to be passed to Barhale Construction.

Local emergency services information is to be included in the Health and Safety File.

Site to be designated a "hard hat area" for the duration of works.

WRG Driver Authorisation scheme will operate at all times for all classes of plant on the site.

First aid provision on site will include:

- one HSE First Aid Kit for up to 50 employees
- additional eyewash facilities (2 x 500ml bottles minimum)
- welfare kit

Each wrg vehicle will carry a First Aid kit.

Each volunteer will be issued with

- a safety helmet to BS 5240

In addition, where the job dictates, the volunteer will be issued with:

- eye protection to BS2092
- hearing protection to BS5108
- disposable nuisance dustmasks to EN149
- suitable gloves

Site Specific Safety Considerations

It is assumed that Barhale Construction will have exposed the weir and no excavation (other than manual) will be required.

It is assumed that access to the site compound and associated fuel/COSHH stores will be available (security to be discussed with MKP and Barhale).

Where building materials will exceed 25Kg appropriate lifting techniques will be employed.

Barhale Construction is to inform WRG if any safety signs are required (in addition to the ones described below).

Although the exact nature of the job required cannot be assessed until the old brick fascia has been removed it is not envisaged that the two options (repoint/patch old wall or rebuild new fascia) will be significantly different in terms of hazard assessment and safety policy. This plan should be acceptable for both, if the job assessment changes significantly then the Health and Safety plan should be rewritten.

Where grass is to be removed the turf should be removed so that it can be replaced after the works are completed.

CDM

- Barhale Construction are responsible for all notifications to HSE (form F10, etc.)
- Barhale Construction are to supply all details of known or suspected hazards for the Health and Safety File
- Barhale Construction are, for the purposes of CDM, considered to be the Principal Contractor and Planning Supervisor
- WRG are, for the purposes of CDM, considered to be a sub contractor, volunteer numbers will not exceed 15 and hours should not exceed 8 per day
- The WRG contact before the work is Mike Palmer (0121 472 2882)
- The WRG site leader is Mike Palmer (29th March - 5th April)

Emergency Procedures

- Location of the nearest 24 hour Accident and Emergency Hospital is to be stored in the Site Health and Safety File and in all WRG vehicles
- Location of nearest public phone is to be stored in the Site Health and Safety File and in all WRG vehicles
- Site mobile phone is to be available on site at all times (0850 422156)
- One emergency WRG vehicle is to remain on site at all times
- On site there will always be one nominated individual (usually the Site Leader) to take charge in the event of an emergency

Pedestrians

- The works do not block any rights of way but pedestrians can be expected to approach the works. Lamp irons and orange hazard fencing will be required to fence off the area of the works. A sign at each end of the weir should warn people not to breach the fence.
- Temporary fencing (orange mesh and lamp-irons) is to be used to prevent access to any other unsafe areas.
- Ground surfaces need to be kept clean between the weir works and the site compound.
- Consideration will need to be given to loss of installed fencing overnight by vandals.

COSHH

- All relevant COSHH data sheets will be available in the Site Health and Safety File.

Liaison

- A contact name and number is requested for Barhale Construction.
- A contact name and number is requested for the Leasowes Park staff for use in emergency.

TASK	Refer to section In Guide:	SAFETY
I. Install safety screens, fencing and signs.	C	Consider all pedestrian access routes (inc. trespassers). Ensure no unauthorised access to incomplete works. This to be checked/modified on an "as required" basis.
II. Agree positions of supply stores (including fuel)	C/D/E	Ensure no materials are stacked where safe access for loading/unloading is compromised. Public access to stores is not permitted. Fuel and COSHH stores to be safe, lockable and marked.
III. Remove old face using:		
A. Manual (hammer and chisel)	CH	Eye and hand protection to be provided.
B. Mechanical (Electric demolition hammers)	PH	Eye, ear and hand protection to be provided. Hammers to be 110v and kept clear of the water. Noise levels to the public to be checked.
iv. Clean old bricks for reuses:	CH	Eye protection and dust masks to be used. Dust nuisance to public to be minimised.
v. Refurbish weir wall:		
A. Grind out old motor joints using angle grinders.	C H P	Eye protection and dust masks to be used. Dust nuisance to public to be minimised.
B. Demolish poor brickwork.	J	Ensure stability of main wall is not compromised.
C. Reinstate brickwork and re point motor joints.	E H	All mortar mixing to follow normal guidelines, eye protection to be worn, gloves to be available.
D. Excavate trial section behind weir wall and backfill with waterproofed concrete if required.	J E	
vi. Refurbish weir lip		
A. Manually expose weir face:	L	
B. Remove weir lip, clean bullnose bricks and reset lip.	H E	Eye protection and dust masks to be used. Dust nuisance to public to be minimised.
C. Pack soil back upto weir lip.		
vii. Clear site and make safe.	C	Ensure no dangerous materials left on site and all temporary works are removed.

APPENDIX 3 – COMMON HEALTH AND SAFETY ABBREVIATIONS AND CDM DEFINITIONS

These may help you in your dealings with Health and Safety.

ALARP	–	As low as reasonably practicable
BA	–	Breathing Apparatus
COSHH	–	Control of Substances Hazardous to Health Regulations 1988 and 1994
HSE	–	Health and Safety Executive
NaW	–	Noise at Work Regulations
PPE	–	Personal Protective Equipment
PPEaW	–	Personal Protective Equipment at Work Regulations
RIDDOR	–	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1985
RPE	–	Respiratory Protection Equipment

As mentioned previously CDM attempts to cover the whole construction industry and as a result the legislation has many, many clauses and definitions. Two that are particularly of interest to WRG and Restoration Groups are; Construction works and Structure.

Construction works:

- The carrying out of any building, civil engineering or engineering construction work and includes the alteration, conversion, fitting out, commissioning, renovation, repair, upkeep, redecoration or maintenance (including cleaning by high pressure water jets, shotblasting, or corrosive/toxic chemicals. The demolition, dismantling or de-commissioning of a "structure",

or

- the preparation of a site for an intended "structure" includes site clearance, exploration, investigation, excavation of the site and laying or installing the foundations,

or

- the assembly or disassembly of sectional and prefabricated "structures",

or

- the removal of a "structure" or any waste resulting from the demolition or dismantling of the same,

or

- the installation of, commissioning, maintenance, repair of removal of mechanical, gas, compressed air, hydraulic, telecommunications, computer or similar services fixed in or to a "structure".

Structure:

- Any building, steel or reinforced concrete structure, rail or tram lines, dock, harbour, inland navigation tunnel, shaft, bridge, viaduct, waterworks, reservoir, pipeline, cable, aqueduct, sewer, sewage works, gas holder, road, airfield, sea defence works, river works, drainage works, earth works, lagoon, dam, wall, caisson, mast, tower, pylon, under ground tank, earth retaining structure, structure designed to preserve or alter any natural features,

or

- similar structures i.e., formworks, false works, scaffold, or other temporary structure designed or used to provide support or means of access during construction work,

or

- fixed plant from which there is a risk that a person can fall more than two metres during installation, commissioning, de-commissioning or dismantling work.

Practical Restoration Handbook

Health & Safety - Section 4
Control of Substances Hazardous to Health (COSHH)

by

Dave Carnell

Please note that, for convenience, the Practical Restoration Handbook "Health & Safety" chapter is split into 4 sections:

1. Site Aspects
2. Personal Safety and Insurance
3. Construction Design and Management Regulations
4. Control of Substances Hazardous to Health

Although these sections are primarily separate there are subjects which overlap and so all four sections must be considered as one chapter. It is essential that all four sections are read together to get an adequate understanding of the Health and Safety requirements for waterway restoration.

CONTENTS

1. INTRODUCTION TO CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH (COSHH 1999)

1.1 Perhaps more than any other Health and Safety legislation the Control of Substances Hazardous to Health (COSHH 1999) is ignored by many volunteers as "I work in an office all week – I'm hardly going to be overexposed by a bit of weed killer at the weekend" and "oh that sort of thing only counts if you use the stuff all day long". Both of these assumptions are not only false but very dangerous. With proper precautions, the risk of being harmed by even the most hazardous substance can be very small, but there can be a high risk even from a substance that is not particularly hazardous if exposure is excessive.

1.2 Nor is it just a case of strapping on goggles or a dust-mask. COSHH requires a number of steps to be taken before personal protective equipment (PPE) is used: PPE is a last resort.

1.3 COSHH aims to protect employees and others who may be affected e.g. the public, from the health risks arising from exposure to substances hazardous to health at work. It places duties on employers, self employed people, contractors, sub-contractors and employees. COSHH requires employers to weigh up risks to the health of their employees arising from exposure to hazardous substances and to prevent, or where this is not reasonably practicable, adequately control exposure. They are also required to provide suitable and sufficient information, instruction and training and may also have to monitor employees' exposure to a hazardous substance and place them under health surveillance.

1.4 Given the above definition it is not easy to see exactly where a voluntary restoration scheme fits into this regime. this is especially the case where a restoration scheme operates on a mix of paid employees, "new deal" type labour, local volunteers and visiting volunteer groups.

1.5 It is best practice to consider the local Society or Trust to be the employer and to place the other groups in the most appropriate category from the list above. The Trusts own volunteers are most likely to be considered employees. A visiting group who only attend the site to make a small contribution to an ongoing project would most likely fall into the sub-contractor post, whereas a Canal Camp that undertook a self-contained complete project might be considered to be a contractor. The exact positioning in the management structure should be clearly understood by all parties.

1.6 Effective application of the COSHH regulations involves all parties affected by an operation undertaking the following:

(a) exchanging all relevant information about the operation

(b) agreeing before the work begins how co-operation and co-ordination between them is to be managed

(c) allocating functions and responsibilities to those who can most effectively control the work.

1.7 Other considerations to be taken into account are:

(a) does the work require specialist knowledge and who has this knowledge?

(b) how is the work of one contractor likely to affect others?

(c) what control measures are required and who is the most appropriate person to apply them?

1.8 In addition the employer has duties in relation to other people at the site and other people likely to be affected (e.g. the public).

1.9 Further details of an example structure, and its application to a restoration project are given in Section 11.

1.10 Discussion of common materials and procedures is given in Appendix 3 and some examples of COSHH assessments are given in Appendix 4. In both these cases they are given as examples only. They should not be applied directly to a restoration scheme without full consideration of all the relevant aspects of that particular project.

1.11 Additional information is given in the section "Further Reading" and a great many guidance notes on materials and processes are listed in the Appendix One. It is recommended that any documents appropriate to your societies work are obtained and read.

2. WHAT IS MEANT BY "SUBSTANCES HAZARDOUS TO HEALTH"?

2.1 Under COSHH the term "a substance hazardous to health" has a specific meaning. It covers:

- Substances or mixtures of substances classified as dangerous to health under the current CHIP regulations. Many dangerous substances, though not all, are listed in "The Approved Supply List – Information approved for the classification and labelling of substances and preparations dangerous for supply". (These are part of the CHIP regulations);
- Substances with occupational exposure limits – listed in HSEs publication EH40 "Occupational Exposure Limits";
- Biological agents (bacteria and other micro organisms), if directly connected with the work or if exposure is incidental, such a farming or healthcare;
- Any kind of dust in a specified concentration;
- Any other substance which has comparable hazards to people health, but which for some technical reasons may not be specifically covered by CHIP e.g. some pesticides, cosmetics or substances produced in chemical processes.

2.2 The CHIP regulations mentioned above are the Chemical (Hazard Information and Packaging for Supply) Regulations 1994. The main objective of these regulations is to ensure that users of dangerous chemicals are supplied with enough information to protect people and the environment from the ill effects of those chemicals. They are particularly concerned with classification (identification of the hazard), packaging and labelling including requirements for safety data sheets, which provide information about the hazards of the substances and preparations concerned.

2.3 The most common considerations for waterway restoration are: cement, fuel and oils, agricultural chemicals, paint and particulates/gases of various forms. However the very nature of waterway restoration is so varied that there are lot of other more specific ones that need to be considered.

3. ASSESSMENTS

3.1 One of the key requirements under COSHH is the assessment. No work may commence or continue which is liable to expose an employee to a substance hazardous to health unless a suitable and sufficient assessment of the risk to health has been carried out. Employers are legally responsible for the assessment and should ensure that the person carrying it out is competent to do so. They should have sufficient knowledge, skill and experience to be able to perform the work effectively.

3.2 A suitable and sufficient assessment should include:

- Looking to see which hazardous substances are present
- Thinking about the risks they represent to peoples health
- Where there are significant risks, determining how much and how often the substance is used and how hazardous is it
- Deciding the action needed to prevent exposure or reduce it so far as is reasonably practicable
- Determining what information, instruction and training is required

3.3 The COSHH assessment form given in Appendix 2 has been found to be suitable for many restoration schemes. It comprises of two sides – the Hazard Indentification side and the Risk Assessment side. The Hazard Identification side should be completed from the suppliers' data for each of the substances to be assessed. This is usually obtained from the Materials Safety Data Sheet (MSDS) that manufacturers should supply with their products.

3.4 Once the first side is completed, the actual use of the substance should be observed and the Risk Assessment side of the form should be completed.

3.5 Forms completed by the Author and used by WRG are included in Appendix 4, and they show the type of information required. The example assessments included with this Chapter are NOT an assessment of the work carried out on your sites: the conditions and circumstances of use of each substance MUST be practically investigated by the person(s) making the assessment. However, the Hazard Identification side of the form may be used unchanged by site leaders/managers for the preparation of their own assessments. Additionally if the method of use observed is identical to, or closely corresponds with that set out on the example form, similar conclusions may be drawn concerning the risk to health and any further action required.

3.6 The risk assessment should be reviewed regularly but definitely;

- At not more than five yearly intervals;
- Where there is evidence to think that it may no longer be valid, for example from the results of health surveillance, or a confirmed case of work related disease or
- Where there has been a significant change in the work such as in the volume or rate of production.

4. SITE ASSESSMENT RECORDS

4.1 It is important that Site Managers, Site Leaders and other personnel on site have a record of assessments carried out for specific materials and processes. Other people will also require evidence that COSHH assessments have been carried out and that suitable control measures have been specified. These may well include members of your Trust or Societies "management", Health and Safety Executive officers and local authority officers. Once an assessment has been carried out and the main conclusions and control measures are recorded onto a single form, forms should be kept up to date and be available on each site.

4.2 Once the Site Assessment Forms are complete for each site they should be referred to by the Site Leader/Manager or other responsible personnel. If there is any doubt concerning the use of a particular substance or the appropriate control measures to apply, the Site Assessment Form should be consulted. If the proposed method of use or quantity of substance to be used is very different from that stated on the Assessment Form the Site Leader/Manager should reassess the situation and produce an additional assessment to cover the new circumstances.

4.3 Assistance in carrying out assessments may be obtained from the Author (contact via IWA/WRG Head Office).

5. CONTROL MEASURES

5.1 Employers must ensure that the exposure of employees to hazardous substances (e.g. inhalation, ingestion, absorption through the skin or contact with the skin) is either prevented or adequately controlled. If prevention is not reasonably practicable exposure should be adequately controlled by one or more of the measures outlined in the regulations. Only as a last resort should personal protective equipment (PPE) be provided.

5.2 Prevention of exposure

- Elimination of the substance
- Substitution by a less hazardous substance
- Changing the method of work

5.3 Control of exposure

- Process control to reduce emission levels
- Totally enclosing the process
- Local exhaust ventilation (LEV)
- Personal Protective Equipment

5.4 For most sites in waterways restoration the work is outdoors and forced ventilation is not usually necessary. However in workshops, buildings or similarly confined spaces such steps may be required.

6. MAINTENANCE, EXAMINATION AND TEST OF CONTROL MEASURES

6.1 Employers must ensure that control measures provided are kept in efficient working order, in good repair and in the case of PPE in a clean condition. Engineering control measures should receive a visual check at least once every week. Engineering controls and respiratory protective equipment have to be examined and, where appropriate, tested at suitable intervals. All local exhaust ventilation (LEV) plant should be thoroughly examined and tested by a competent person at least every fourteen months, and in some cases more frequently. Respiratory protective equipment (RPE) (other than disposable RPE) must be examined and, where appropriate, tested at suitable intervals. Any defects should be corrected. A record of all examinations, tests and corrective action must be kept.

7. EATING, DRINKING, SMOKING AND WASHING

7.1 In order to reduce the risk of ingestion of substances hazardous to health, persons should not eat, chew, drink or smoke in places which are contaminated by substances hazardous to health. Wherever it is necessary to prohibit eating or drinking, suitable facilities should be set aside for those activities in an uncontaminated area.

7.2 Adequate washing facilities should be provided in order to enable persons exposed to meet a standard of personal hygiene consistent with adequate control of exposure and the need to avoid the spread of substances hazardous to health. The washing facilities should be conveniently accessible but situated so that they do not themselves become contaminated.

8. OCCUPATIONAL EXPOSURE LIMITS

8.1 Under COSHH, there are two different types of Occupational exposure limit (OEL) for hazardous substances: maximum exposure limits (MEL) and occupational exposure standards (OES).

8.2 A MEL is set for substances which may cause serious health effects such as cancer or occupational asthma, and for which either "safe" levels of exposure are not known or control to those levels is not reasonably practicable. The MEL is the maximum concentration of an airborne substance, averaged over a reference period to which employees may be exposed by inhalation under any circumstances.

8.3 An OES is set for less hazardous substances at a level that, based on current research, will not normally damage the health of workers exposed to it by inhalation day after day. OES apply only to people at work and to conditions where the atmospheric pressure is normal i.e. between 900 and 1100 millibars.

8.4 Both types of limit are approved by the Health and Safety Commission and refer to concentrations of hazardous substances in the air that people breathe, averaged over a specified period of time referred to as time weighted averaged (TWA). Two time periods are used longer term (8 hours) and short term (15 mins).

8.5 HSEs annually reviewed publication EH40 "Occupational Exposure Limits" includes the list of substances assigned MELS and OES, approved methods for averaging over the specified reference periods, an explanation of the terms "respirable" and "total inhalable", and related material.

Substances assigned a maximum exposure limit MEL

8.6 Under regulation 7(6), controls of exposure by inhalation to a substance assigned a MEL will only be regarded as adequate if the exposure is reduced so far as is reasonably practicable and, in any case, below the MEL.

8.7 To comply with this requirement for substances with an 8 hour long term reference period, employers will normally have to carry out a programme of air monitoring in accordance with Regulation 10, unless the risk assessment made under Regulation 6 shows that the level of exposure is most unlikely to ever exceed the MEL. This will help show, if it is the case, the MEL is not exceeded, i.e. an occasional result above the MEL is not really significant and does not necessarily mean that the employer has failed to maintain adequate control.

8.8 Some substances for which MELs have been approved have been assigned short term MELs (e.g. 15 min reference period). These substances can cause acute health effects and the purpose of the short term limit is to prevent the adverse health effects occurring from brief exposures to the substance. For this reason, **short term limits should never be exceeded**.

8.9 The extent to which employers can reduce exposure below the MEL will depend on the type of risk presented by the substance, weighed against the cost and the effort involved in taking measures to reduce the risk. Regulation 7(6), together with Regulation 16, imposes a duty on employers to take all reasonable precautions and to exercise all due diligence to achieve adequate control for substances assigned MELs.

Substances assigned an Occupational Exposure Standard (OES)

8.10 For a substance which has been assigned an OES, exposure should be reduced to the level set by the standard. However, if exposure exceeds the OES, then control will still be considered adequate, provided that the employer:

- has identified why the OES has been exceeded; and
- is taking appropriate steps to comply with the OES as soon as reasonably practicable.

8.11 In these circumstances, the employer's objective must be to reduce exposure to the OES, but achieving this may take some time. In deciding how urgently to take the necessary remedial action, the employer needs to consider the extent and cost of the measures in relation to the level and possible consequences of the "over" exposure.

9. PERSONAL PROTECTIVE EQUIPMENT (PPE)

9.1 When considering PPE it is not just enough to have the correct item available for the volunteers. It must be in serviceable condition and be correctly rated for the job. Respirators have different grades depending on whether they are to be used as protection against non toxic particulates or against organic vapours for

example. Similarly gloves offer differing levels of protection, and eye protection has many different grades depending, for example, on whether hot metals or caustic products are used.

9.2 Adequate, appropriate storage must be made available for volunteers PPE; clean, dry conditions without sunlight, etc.

10. INFORMATION, INSTRUCTION AND TRAINING

10.1 Employers must ensure that any employee required to work with substances hazardous to health has the necessary information, instruction and training to carry out the work in safety. In particular employees must be informed about the risk to health created by the work and precautions which must be taken. When monitoring is carried out employees or their representatives must be informed if a maximum exposure limit has been exceeded.

11. AN EXAMPLE STRUCTURE FOR A RESTORATION SCHEME

11.1 As many restoration sites operate on a multi-volunteer-group basis, it is important that the respective duties and responsibilities for health and safety action are defined. For example it may well be that a local scheme has no experience of cement products and so asks a WRG group to visit and do the "one off" concrete pour they require. The Construction Industry Advisory Committee on Health and Safety (CONIAC) guidance on managing health and safety explains the principles involved. In addition the COSHH Accepted Code Of Practice (Regulation 3) gives further details on the duties that apply to each party.

11.2 Although it is not the only way to implement a COSHH management the Author recommends implementation of COSHH should be integrated with the overall management strategy as follows:

11.2.1 **The Main Resident Group should:**

(a) Carry out assessments of hazardous materials and introduce controls to remove potential hazards for his own workers and others

(b) Ensure that arrangements are in order for implementing their suggested controls in terms of equipment, training and supervision

(c) Ensure that their site Leaders are adequately trained regarding the implementation of COSHH and ensure that employees are trained with regard to the control measures required

(d) Co-ordinate the management of COSHH

(e) Ensure that visiting groups have carried out their own assessments (if necessary) and that their arrangements to implement their suggested controls are adequate in terms of equipment, training and supervision

(f) Retain the register of their assessments at each site and have sight of any additional visiting groups assessment records before they start work

(g) Ensure that the appropriate control measures are implemented and maintained as the work proceeds with inspections of equipment being completed where appropriate

(h) Ensure that adequate supervision is provided to implement the suggested controls

(i) Ensure that no work is continued involving a substance hazardous to health unless an assessment has been carried out and that adequate controls are implemented. Those completing the assessment must be trained to identify substances hazardous to health, assess the risk to health arising from work practice: and select adequate control measures

(j) Arrange for health surveillance checks when appropriate

11.2.2 **The Site Leader/Manager should:**

(a) Be familiar with his own group's COSHH documentation and know how to use it

(b) Ensure that employees and volunteers under his control follow the guidance given in the assessment summary sheets

(c) Identify new products or products being used in different ways requiring assessment and ensure the summary sheet is completed before the product is used

(d) Ensure that other groups have COSHH Assessment reports for products they bring on site and that the other site workers' health is not endangered by these products.

11.2.3 **Visiting Groups should:**

(a) Prepare an assessment of hazardous materials and introduce controls to remove hazards for his own volunteers and others on the site. These assessments must be kept up to date.

(b) Submit records of their assessment to the main resident group

(c) Co-operate with the main group in the co-ordination of COSHH control measures

(d) Implement their suggested controls and participate in the controls being implemented by the main group

(e) Train their volunteers in the control measures to be taken and provide adequate supervision as necessary

(f) Ensure the necessary equipment to implement these controls is available and ensure it is properly maintained

(g) Arrange for health surveillance checks where appropriate.

11.2.4 **Volunteers (and Employees) should:**

(a) Make proper use of the control measures provided

(b) Report any defects in the equipment provided

(c) Assist their management in implementing their duties under COSHH

(d) Attend as directed by their leader for health surveillance checks.

12. MATERIALS INVENTORY

12.1 A full inventory of all materials in use should be maintained. the inventory should include details of the use of the material and the rate of consumption. The suppliers hazard data sheet or other information about each material should be filed to allow retrieval for future reference. An assessment of the risks to health arising from the use of materials identified as substances hazardous to health must be carried out. The use of materials that have been identified as hazardous to health must be assessed to determine the risk to health. If there is no risk to health or the risk is trivial, the risk assessment is complete and nothing more is required at this stage. But if there are significant risks then steps should be taken to protect employees (and others) health. Every new material introduced, along with the supporting hazard data sheets, should be included in the materials inventory.

12.2 New materials must not be used unless the risk to health has been assessed. It is recommended that the named leader or member of management responsible for ensuring that the group complies with the COSHH Regulations should put in writing the company policy and procedures for selecting new materials and assessing to be used and ensure that the company materials inventory is kept up to date.

13. FURTHER READING

13.1 HSE publish the General COSHH Accepted Code of Practice which gives details of the regulations and how they affect all parties and how they should be implemented.

13.2 HSE also produced a "brief guide to COSHH regulations" (INDG136 (rev1)

13.3 ARCO produce a Personal Protection Catalogue that has a very wide range of products for a variety of tasks and gives good advice on PPE:

Arco Limited
PO Box 21
Waverly Street
Hull
HU1 2SJ

13.4 There are a great many web pages that offer advice on COSHH (usually in an attempt to get you to buy safety management software). However some pages worth accessing are:

www.open.gov.uk/hse/pubns/coshh1
www.open.gov.uk/hse/pubns/coshh2
www.signcentre.co.uk/coshh
www.physchem.ox.ac.uk/msds

APPENDIX 1 – LIST OF TEXTS AND PUBLICATIONS REFERENCE IN THIS CHAPTER

Note that texts are listed under the section of the Chapter in which they are primarily referenced but may also be referred to in other sections. It is recommended that these texts are obtained as they will assist greatly with Health and Safety planning.

Section 1 – Site Aspects

Code	Title	Available from
	HSE Construction Summary Sheets	
SS2(rev)	Safe Use of Ladders	HSE
SS3 (rev)	General Access Scaffolds	HSE
SS6	Portable Electric Tools and Equipment	HSE
SS8 (rev)	Safety in Excavations	HSE
SS11(rev)	Safe Use of Propane and other LPG cylinders	HSE
SS12	Flame Cutting and Welding with Compressed Gases	HSE
SS16	The Control of Substances Hazardous to Health	HSE
SS17	Construction Site Health and Safety Checklist	HSE
SS26	Cement	HSE
SS28-35	Your Body at Risk: Are you Properly Protected?	HSE
SS50	Personal Protective Equipment: Safety Helmets	HSE
na	Noise in Construction	HSE
na	Construction (Working Places) Regulations 1966	HMSO
na	Carriage of Dangerous Substances in Packages Regulation	HMSO
na	Health and Safety at Work Act	HMSO

Section 2 - Personal Safety and Insurance

Code	Title	Available from
green book	Volunteers' Health and Safety Guide	WRG
B1510	Accident Record Book	HSE
IND(G) 84L	Leptospirosis - are you at risk?	HSE
SS18	Provision of Welfare at Fixed Construction Sites	HSE
SS46	Provision of Welfare at Transient Construction Sites	HSE
SS51	Construction Fire Safety	HSE
na	Insurance Guidelines	IWA

Section 3 - Construction Design and Management Regulations

Code	Title	Available from
na	Construction, Design and Management Regulations 1994	HMSO
F10	Notification of project to HSE	HSE
C400	CDM Regulations - How the Regulations affect you!	HSE
SS17	Construction Site Health and Safety Checklist	HSE
SS40	The Role of the Planning Supervisor	HSE
SS44	The Health and Safety File	HSE
	Guide to the Provision and Use of Work Equipment Regulations 1998	HSE
	Guide to the Lifting Operations and Lifting Equipment Regulations 1998	HSE
F91/CE	Lifting Appliances Record	HMSO
F91/A	Scaffolding Record	HMSO
F91/J	Lifting Gear Record	HMSO
F2202	Welfare Arrangements Record	HMSO
na	Volunteers Working Safely	BW

Section 4 - Control of Substances Hazardous to Health

Code	Title	Available from
na	Control of Substances Hazardous to Health 1988 & 1994	HMSO
na	Health and Safety at Work Act, 1974, 1992	HMSO
na	Factories Act 1961 Revised	HMSO
na	Health and Safety Information, Employees Regulations 1989	HMSO
na	Highly Flammable Liquids and Liquified	HMSO
	Petroleum Gases Regulations 1972	
na	Approved Code of Practice Control of Substances Hazardous to Health 1994 (ACOPS) **Health and Safety Executive Guidance Notes**	HMSO
	Environmental Hygiene Series:	
EH17	Petroleum based adhesives in Building Operations	HSE
EH8	Arsenic: toxic hazards and precautions	HSE
EH9	Spraying of highly flammable liquids	HSE
EH16	Isocyanates: toxic hazards and precautions	HSE
EH22	Ventilation of Buildings	HSE
EH26	Occupational Skin Diseases: Health and Safety Precautions	HSE
EH40	Occupational Exposure Limits (Revised Annually)	HSE
EH42	Monitoring Strategies for Toxic Substances	HSE
EH43	Carbon Monoxide	HSE
EH44	Dust in the Workplace: general principles of protection	HSE
EH46	Exposure to Mineral Wools	HSE
	General Series:	
GS5	Entry into Confined Spaces	HSE
GS29/4/	Health and Safety in Demolition Work. Part 4	HSE

GS46	In Situ Timber Treatment using Timber Preservatives; health and environmental precautions	
	Medical Series:	
MS8	Isocayanates; medical surveillance	HSE
MS15	Welding	HSE
	Hazard Information Sheets	
No. 1	Cements 1985	HSE
No. 5	Solvents 1988	HSE
No. 7	Skin Hazards 1988	HSE
No. 8	Pesticides 1989	HSE
	Construction Summary Sheets	
SS15	Confined Spaces 1988	HSE
SS24	Chemical Cleaners	HSE
SS26	Cement	HSE
SS27	Solvents	HSE
SS36	Silica	HSE
	Respiratory Protective Equipment	
BS4275	Recommendations for the selection, use and maintenance of Respiratory Protective Equipment 1974	HSE
	Respiratory Protective Equipment (RPE): Legislative Requirements and lists of HSE approved standards and type approved equipment 1989	HSE
	Health Safety Leaflets	
	Introducing COSHH. A brief guide for all employers to the new requirements for controlling hazardous substances in the workplace	
	Introducing Assessment: a simplified guide for employers	
	Managing Health and Safety in Construction	
	Part 1: Principals and Applications to main contractor/visiting group projects. HMSO 1988	
	Part 2: Management Contracting HMSO 1988	
	Hazard and Risks Explained	
	Control of Hardwood Dusts 1987	
	Health Hazards to Painters 1989	
	Miscellaneous Documents	
	A Guide to Safe Use of Chemicals in Construction	CIRIA
	Construction Safety Manual : Section 25	BEC/BAS
	Development of Contaminated Land; Dept. Of Environment Circular 21/87	DoETR
	COSHH In Construction : A BEC Guide	BEC
L101	Safe Work in Confined Spaces	HSE

Addresses for these texts

Health and Safety Executive
HSE Books
PO Box 1999
Sudbury
Suffolk
CO10 6FS

HMSO
Any Local HMSO bookshop

Ciria
6 Storeys Gate
Westminster
London,
SW1P 3AU
0171 222 8891
www.ciria.org.uk

BEC Publications
Federation House
2309 Coventry Road
Sheldon
Birmingham
B26 3PL
0121 742 0824

Inland Waterways Association
Waterway Recovery Group Ltd
PO Box 114
Rickmansworth
WD3 1LT
01923 711114

APPENDIX 2 – COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME:

Supplier:

Internal Reference Code:

TOXIC INGREDIENTS:	MEL	OES	OTHER HAZARDS

DESCRIPTION OF SUBSTANCE:

HAZARDS:

WARNINGS:

HARMFUL	IRRITANT	TOXIC	EXPLOSIVE	CORROSIVE	OXIDISING	HIGHLY FLAMMABLE

FIRST AID:

STORAGE PROCEDURES:

COSHH RISK ASSESSMENT

SUBSTANCE	**REF. CODE**
DESCRIPTION OF USE: **Department/Site** **Task**	
QUANTITIES USED:	
ASSESSMENT OF RISK: **Air Monitoring Results**	
FURTHER ACTION REQUIRED: **Recommended Control Measures** **Spillage Procedures**	

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: ..... DATE: .....

APPENDIX 3

Discussion and guidance on various common materials and procedures.

Concrete and Cement

Concrete used on sites for foundations and other surface structures is often delivered wet and ready mixed and presents no inhalation risk. When levelling and placing by hand skin contact may occur. Where there is prolonged contact between wet concrete and skin there is a risk of cement burns.

The risk to health from cement burns is significant. Contact between wet cement and unprotected skin must be avoided. When this is impractical skin must be protected by the wearing of gloves. Skin which has become covered with wet cement should be washed immediately to prevent burning.

Epoxy Mortars

Epoxy mortars, accelerators and plasticisers are used in concrete and bricklaying activities to aid their pouring and working. These additives may contain Epoxypropoxyl, Butane, Trimethyl Hexamethylenadiamines and should be handled where there is adequate ventilation.

Since there is a significant risk to skin and eye irritation when handling these products contact between unprotected skin should be avoided. Where this is not practical gloves and goggles should be worn during the preparation and application.

Stone and Hardcore Filling

Stone and hardcore are used for foundations and hardstandings, etc. They are tipped in the desired location and levelled by hand. During tipping and levelling a dust cloud may be formed which will persist for several minutes before being dispersed by the wind. The dust produced may be present in substantial quantities for short periods. This dust may be specifically covered by COSHH regulations depending on its composition (e.g. if it contained silica). Equally it may be covered just by virtue of its concentration. COSHH applies to any dust when present at a concentration in air equal or greater than 10mg/m^3, as a time weighted average over an 8 hour period of total inhalable dust, or 4mg/m^3 as a time weighted average over an 8 hour period of respirable dust.

However unless work is very intensive the dust from these operations is unlikely to be considered a substance hazardous to health and so COSHH regulations will not cover this situation. Never the less the personnel involved should stand upwind of the dust and, during dry weather, spraying the stone prior to tipping will reduce the dust to a minimum and should be considered best practice.

Cutting Concrete Pipes

Concrete pipes, slabs and other products are generally cut outdoors using a disc cutter. This activity may last from 30 mins to a number of days. The dust produced during the cutting of concrete products may contain small quantities of crystalline silica. Repeated full shift exposures to respirable crystalline silica is known to cause silicosis. However an exposure to such dust for 30 minutes once per week does not constitute a significant risk to health. Should the exposure to dust take place indoors or increase to occupy the majority of the working day then this exposure should be reassessed. If there is a daily exposure of two or three hours over several weeks the risk to health will increase. In these circumstances the worker should be provided with approved respiratory protection such as 3M 8800 disposable dust masks when cutting concrete products.

Washed Sand

The sand used on most sites is a type which contains a large particle size which does not readily become airborne and therefore presents no inhalation risk. The manual handling of washed sand does not generally generate sufficient airborne dust to constitute a hazard to health. However during very dry weather high winds may entrain sand particles which may cause eye irritation (particularly for dumper drivers moving sand).

Where specialist applications require the use of sands with fine grain sizes, high silica content or coloured varieties separate assessments of the risk to health should be made.

Mastic Sealants

Mastic is used occasionally on most sites for sealing around woodwork and other sealant applications. The mastic used may contain Toluene, Xylene, Methyl Ethyl, Ketone, Ethyl Benzene or other similar solvents which slowly evaporate into the atmosphere as the mastic cures.

Mastics can present a significant risk to health by skin contact and inhalation. The solvent vapour is released in small quantities. When used out of doors or a well ventilated room the risk to health by inhalation is not significant. However when used in confined spaces the solvent vapour concentration may rise to a level which represents a significant risk to health. The early symptoms of solvent inhalation are headaches, then slight nausea followed by dizziness and disorientation. Mastics must only be used in well ventilated areas.

Repeated and prolonged skin contact may cause irritation and so should be avoided by wearing gloves. Workers should be informed of the hazards associated with the use of mastics and the risk to health arising from the use specified on the site. Workers must be trained to use the product as directed by the manufacturer and take the precautions as stipulated.

Adhesives

There are a wide variety of adhesives available containing a wide range of solvents, bitumen and rubbers. The solvents commonly encountered include Toluene, Xylene, Methyl Ethyl Ketone, Ethyl Benzene. These adhesives are used for fixing clay and ceramic tiles, wood blocks, insulation board, fascia board, laminates, etc and are applied by brush, trowel or roller.

Solvent based adhesive can present a significant risk to health by skin contact and inhalation. The solvent vapour is released in small quantities. When used outdoors or in a well-ventilated room the risk to health by inhalation is not significant. However when used in confined spaces the solvent vapour concentration may rise to a level which represents a significant risk to health. The early symptoms of solvent inhalation are headaches, then slight nausea followed by dizziness and disorientation. Adhesives must only be used in well ventilated areas. Solvent based adhesives must only be used in well ventilated areas.

Repeated and prolonged skin contact may cause irritation and so should be avoided by wearing gloves. Workers should be informed of the hazards associated with the use of adhesives and the risk to health arising from the use specified on the site. Workers must be trained to use the product as directed by the manufacturer and take the precautions as stipulated.

Softwoods

The cutting of softwood timber on a site is usually by handsaw, chainsaw or circular saw. These activities may last from 30 minutes per day to a number of days.

The OES for airborne softwood dusts (HSE Guidance note EH40/2000) is 5mg/m^3 averaged over an 8 hour shift. The exposure of workers spending a shift handsawing softwood timber in the open air is likely to be much less than this exposure limit. The risk is therefore not significant.

Hardwoods

The cutting of hardwood timber on a site is usually by handsaw, chainsaw or circular saw. These activities may last from 30 minutes per day to a number of days.

Hardwood dust have been assigned an MEL as long-term exposure to high concentrations to hardwood dust is known to produce nasal cancer. The MEL is 5mg/m^3 averaged over an 8 hour shift. Under the COSHH regulations this is a limit which should not be exceeded and in addition exposure should be reduced to as low a level as reasonably practicable.

However, so long as the hardwood dusts are worked only occasionally in the open air and with hand tools the dust concentrations will be well below the MEL and will not represent a significant risk to health.

Should the use of hardwoods increase, especially if mechanical machining is involved the exposure of the personnel should be assessed. This assessment should include the measurement of personal exposure to the dusts, carried out by a competent person.

Treated Wood

The active ingredients in woods treated with fungicides and pesticides include Lindane, Pentachlorophenol (PCP), Tributyl Tin Oxide (TBTO), and Copper, Chromates and Arsenates (CCA). Whilst these are toxic chemicals the quantities absorbed into the wood are small.

The dust inhalation risk from hand cutting of the wood is not significant, because of the relatively short exposure times and the lack of airborne dust. However mechanical cutting of the wood could present an even higher risk than cutting soft or hard wood because of the presence of copper arsenates and chromates which all have OES of 0.1-2mg/m^3. Handling of treated woods should be accompanied by high standards of hygiene. Hands should be washed regularly, particularly before smoking or handling food.

The burning of such wood releases very high concentrations of arsenic in the smoke. Burning on site should therefore be prohibited.

Treating wood with these substances will involve a significant risk to health and a separate assessment must be carried out.

Machine-made Mineral Fibres (MMMF)

Categories of MMMF are mineral wools, such as glass and stone wools, ceramic fibres (also known as refratory ceramic fibres), special purpose fibres and continuous filament fibres. All have the potential to irritate the skin and eyes, and excessively dusty conditions may irritate the upper respiratory tract. The irritation of the skin and eyes is mainly caused by coarse fibres. While most peoples skin becomes resistant after a period of adaptation, some need to take precautions to protect their skin and a small number may have to move to other work.

It is essential therefore that all work of this nature is undertaken in accordance with the recommendations contained in the HSE guidance notes EH46 "Exposure to Mineral Wools". This recommends the wearing of overalls loose at the neck and cuffs to reduce skin abrasion, and the wearing of approved respirators (e.g. 3M 8800) eye protection and gloves. Where there is the possibility of bodily contamination, showering and changing facilities should be provided.

The exposure limit for fibre glass particles is a MEL of 5mg/m^3 (8 hour TWA) and 2 fibres per ml (8 hour TWA) for superfine particles when measured or calculated by a method approved by the Health and Safety Commission.

Historically there has been concerned that long term inhalation exposure to respirable fibres of glass wool and rock wool might cause lung damage and increase the risk of workers developing lung cancer. Initial studies appeared to show a link between use of these products and lung cancer. However the data was inconsistent and included confounding factors. Recent well conducted research has provided reassurance that there is no provable link.

These substances are subject to CHIP regulations and so guidance can be found at the point of work. Where there is evidence from specified tests that there is no carcinogenic effects then the wools will be classified as "irritant". Where there is no such evidence then the wools will additionally be classified as "category 3 carcinogens" (i.e. substances which cause concern for man owing to their possible carcinogenic effect but in respect of which there is insufficient animal studies to place the substance in a higher classification category).

Ceramic Fibres have been classified as "category 2 carcinogens" because inhalation studies have shown that they can cause cancer in rats and hamsters.

Water Based Paints

These paints have widespread uses for interior decorating and are used continuously for several hours at a time. These paints are water based with other constituents being mainly of low volatility. The paint is applied by brush or roller and these are washed out in buckets of water. Despite the large quantities of paint which is applied there is little contamination of the skin or clothes. The workers wash their hands frequently as a consequence of cleaning brushes and rollers. The risk from the use of emulsion paints is not significant but a good standard of ventilation is recommended because of the odour level.

Solvent Based Paints and Thinners

(Brush and Roller Application)

These paints and varnishes contain solvents which include white spirit, 111 trichloroethane, Methyl Ethyl Ketone or other solvent bases. Painters often spend a full day on gloss painting.

The risk to the health of painters from the inhalation of solvents as the paint dries may be significant. As the paint dries the solvents evaporate into the atmosphere. If the painting is out of doors or in a well ventilated room the solvent vapour concentration will not exceed the OES and the risk to health is not significant. However, in restricted on confined spaces the solvent vapour concentration can rise rapidly and solvent intoxication can occur. The early symptoms of solvent inhalation are headaches, then slight nausea followed by dizziness and disorientation. Unless the exposed person is removed from this atmosphere collapse and asphyxiation may result.

This work must only be used in well ventilated (either natural or forced) areas. Under normal circumstances the need to keep windows and doors open to paint edges will provide sufficient ventilation. On other occasions the unpleasant symptoms of solvent exposure lead the painters to seek fresh air. It is recommended however that there is a clear policy that these paints are only used in well ventilated areas. In addition the painters should be provided with sufficient information and training to appreciate the nature of the risk.

Paint Storage

The correct storage procedures for paints and thinners should be adhered to. Liquids with flash points below 32 degrees are defined to be highly flammable and their use storage and disposal is subject to the provisions of the Highly Flammable Liquids and Liquified Petroleum Gases Regulations. The purchase storage and use of highly flammable liquids should be carefully monitored and the following recommendations adhered to: When there is no highly flammable liquids stored or in use the following recommendations should be considered good practice. Where highly flammable liquids are stored or used the following recommendations are mandatory under the Highly flammable liquids and Liquified Petroleum Gas Regulations.

Solvents, paints and thinners should be stored in a safe position in a separate well ventilated paint store or in the open air. Where the quantity of material stored is less than 50 litres it may be stored in a metal fire resisting cabinet in the painting area. The cabinet door should be closed except where necessary to gain access. There must be arrangements to contain any leakage, or spillage of paint or thinners from the cabinet. All containers of thinners, except those holding less than 5000ml and all stores and cabinets containing thinners should be marked flammable liquid or highly flammable liquid as appropriate.

Smoking should be prohibited in all areas where thinners are used or stored. All rags or paper waste contaminated with paint or thinners should be placed in closed metal bins. Bins containing other waste materials should be located away from any thinners stores and be emptied regularly. The accumulation of waste materials inside the painting area should be kept to a minimum.

Vehicle and Plant Maintenance

Exhaust Gases

The exhaust fumes from petrol driven engines and generators contain mainly carbon monoxide and carbon dioxide. The exhaust fumes from diesel engines contain mainly carbon dioxide and complex hydrocarbons. Care needs to be taken to reduce exposure to these gases and fumes.

The exposure of personnel to exhaust gases should be limited by maintaining the policy of reducing the duration of engine running in garages and plant workshops and ensure there is adequate ventilation. The risk to the health of mechanics from these sources will not be significant provided adequate ventilation is maintained.

Aerosol Lubricants and Penetrant Oils

Several lubricant, penetrant oils, water dispersants and adhesives are used. These substances are known to give rise to dermatitis problems after prolonged exposure. These preparations also contain substances known as hazardous to health by inhalation such as light mineral oils, toluene in impact adhesives and 111 tricholoethane in aerosol release agents.

Provided the quantities of aerosol lubricants and penetrating fluids and adhesives used daily is low and the general ventilation is adequate the risk to health from inhalation is not significant. However aerosol lubricants, penetrants and similar should not be used in confined spaces or pressurised tunnels. Similarly impact adhesives or other preparations should not be used in tunnels or other confined spaces unless there is adequate ventilation.

APPENDIX 4

These example assessments are NOT an assessment of the work carried out on your sites: the conditions and circumstances of use of each substance MUST be practically investigated by the person(s) making the assessment.

However, the Hazard Identification side of the form may be used unchanged by site leaders/managers for the preparation of their own assessments. Additionally if the method of use observed is identical to, or closely corresponds with with that set out on the example form, similar conclusions may be drawn concerning the risk to health and any further action required.

It is important to check that the OELs used are correct at the time of assessment as these are often reviewed in the light of current research. A list of OELs can be found in EH40/2000 "Occupational Exposure Limits 2000" which is reviewed annually and published by HSE.

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Evo Stock Impact Adhesive

Supplier: EVODE Ltd, Common Road, Stafford

Internal Reference Code: A5

TOXIC INGREDIENTS:	MEL	OES	OTHER HAZARDS
Toluene n-Hexane		100ppm 100ppm	

DESCRIPTION OF SUBSTANCE:

Viscous liquid, contact adhesive for laminates, rigis PVC wood chip board, hard board, cork, rubber, leather, metal dense firm fabrics

HAZARDS:

Prolonged exposure to concentrations above the Occupational Exposure Limits may cause headaches, nausea, dizziness, disorientation

WARNINGS:

HARMFUL IRRITANT TOXIC EXPLOSIVE CORROSIVE OXIDISING HIGHLY FLAMMABLE

☐ ☐ ☐ ☐ ☐ ☐ ☐

FIRST AID:

Avoid inhaling vapour, if dizziness or disorientation is evident move subject to fresh air. Seek medical advice

STORAGE PROCEDURES:

Store in a cool dry area

COSHH RISK ASSESSMENT

SUBSTANCE Evo Stock Impact Adhesive **REF. CODE** A5

DESCRIPTION OF USE:
Department/Site Maintenance
Task

Spread thin layer on surface to be joined using spreader. Allow surfaces to become tacky. The substance is never used near naked flame.

QUANTITIES USED: 250ml can, one can last six months

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because the quantity used is low and the product is always used in areas of good general ventilation.

FURTHER ACTION REQUIRED:

Reassess risk to health in twelve months or if quantity used increases greatly

Recommended Control Measures

Always use in areas of good ventilation

Spillage Procedures

Allow to harden and remove physically. Avoid inhaling the vapour

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Aggregates

Supplier: Quarry Products Ltd

Internal Reference Code: A4

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Quartz (silica) TID total inhalable dust RD respirable dust * Under review		* 0.3mg/m^3 TID 0/1mg/m^3 RD	

DESCRIPTION OF SUBSTANCE:

Crushed rock, sand and gravel aggregates, delivered in bulk and tipped from lorry. Dust is produced when tipping or moving large quantities of aggregates

HAZARDS:

If inhaled in excessive quantities or over a prolonged period, respirable dust containing quartz may cause silicosis. Advice on the quantity of quartz in the dust produced from individual aggregates is available from the supplying unit.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

None

STORAGE PROCEDURES:

No special requirements

COSHH RISK ASSESSMENT

SUBSTANCE Natural Aggregates **REF. CODE** C4

DESCRIPTION OF USE:
Department/Site Ground Works
Task

Filling and levelling prior to laying surfaces of roads and drives. The aggregates are delivered to site in bulk and tipped close to the working area. Small quantities, for laying paths and patios, are shovelled into wheel barrows and tipped. Large quantities for drives and roads are moved using a bulldozer.

QUANTITIES USED: Bulk deliveries on a weekly basis

ASSESSMENT OF RISK:
Air Monitoring Results

Risk to health from inhalation of dust is not significant, provided during tipping and up win of any dust produced while working with aggregates.

FURTHER ACTION REQUIRED:

Review assessment in one year

Recommended Control Measures

Dust masks should be worn if working in poorly ventilated areas. In very dry weather spray aggregates with water prior to tipping. Operatives should be informed of the hazard constituted by the dust and how to minimise exposure.

Spillage Procedures

Not applicable

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Washed sand

Supplier: A R C

Internal Reference Code: C 1 4

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Quartz (silica) Total Inhalable Dust Respirable Dust		 0.3mg/m^3 0.1mg/m^3	

DESCRIPTION OF SUBSTANCE:

Sand used for mixing with cement and water to produce mortar

HAZARDS:

Prolonged exposure to silica at concentrations in excess of the MEL may over several years result in the development of silicosis.
Wind blown sand particles may result in eye irritation.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Sand in eyes: Irrigate with running water for 10 mins

STORAGE PROCEDURES:

If stored out of doors keep damp in dry windy weather

COSHH RISK ASSESSMENT

SUBSTANCE Washed sand **REF. CODE** C 1 4

DESCRIPTION OF USE:
Department/Site
Task

Washed sand is mixed with cement to make mortar. Dry sand is shovelled into a cement mixer four or five times per day. Exposure to sand is for approximately fifteen minutes on each occasion the cement mixer is used. Once water is added to the cement mixer no dry sand becomes air borne.

QUANTITIES USED: One tonne per day

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because exposure to silica is well below the levels which would lead to the development of silicosis

FURTHER ACTION REQUIRED:

None

Recommended Control Measures

Wear eye protection in handling sand in dry and very windy conditions

Spillage Procedures

Shovel up. There are no special precautions required.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Unibond, PVA Adhesive and Sealer

Supplier: Unibond Ltd, Tuscan Way, Camberley, Surrey, GU15 3DB

Internal Reference Code: A4

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Poly Vinyl Acetate			

DESCRIPTION OF SUBSTANCE:

Unibond is ready mixed adhesive suitable for most bonding jobs.
It is a liquid which is normally applied by brush or spreader.

HAZARDS:

Prolonged skin contact my cause irritation.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Splashes in eyes: Flood eye with plenty of water for 10 mins
Splashes on skin: Wash thoroughly with soap and water
Ingestion: Drink copious amount of water. Do not induce vomiting
Seek medical advice

STORAGE PROCEDURES:

Store in cool dry area

COSHH RISK ASSESSMENT

SUBSTANCE Unibond PVA **REF. CODE** A4

DESCRIPTION OF USE:
Department/Site Maintenance
Task
Repair of workshop floor. Poured into water to form emulsion, mixed with concrete.

QUANTITIES USED: 1 litre tin per year

ASSESSMENT OF RISK:
Air Monitoring Results

Not significant because of small quantity used and the method of use avoids skin contact.

FURTHER ACTION REQUIRED:

Reassess in twelve months

Recommended Control Measures

No additional control measure recommended

Spillage Procedures

Apply absorbent material and wipe up

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Natural Aggregates

Supplier: Tarmac Roadstone Ltd
Tarmac Quarries

Internal Reference Code: C3

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Silica		*	
TID – Total Inhalable Dust	0.3mg/m^3		
RD – Respirable Dust	TID		
* under review	0.1mg/m^3	RD	

DESCRIPTION OF SUBSTANCE:

Naturally occurring rock, sand and gravel consisting of various minerals which may include quartz

HAZARDS:

Inhalation of quartz at concentrations in excess of the MEL over several years of continuous exposure may result in the development of silicosis.
Wind blown grit may cause eye irritation.

WARNINGS:

HARMFUL	IRRITANT	TOXIC	EXPLOSIVE	CORROSIVE	OXIDISING	HIGHLY FLAMMABLE

FIRST AID:

Grit in eye – bathe eye with optrex
If eye irritation persists, seek medical advice

STORAGE PROCEDURES:

Keep fine particle products damped down in dry weather

COSHH RISK ASSESSMENT

SUBSTANCE Natural Aggregates **REF. CODE** C3

DESCRIPTION OF USE:
Department/Site Construction Sites
Task
Tipping and levelling stone and gravel by mechanical means

QUANTITIES USED: 1 – 20 ton loads intermittently

ASSESSMENT OF RISK:
Air Monitoring Results
Exposure to dust generated by tipping and levelling natural aggregates for short durations of up to one hour, once or twice per week does not represent a significant risk to health. If exposure to dust which may contain quartz becomes continuous a new assessment, including monitoring must be carried out.

FURTHER ACTION REQUIRED:

Review assessment in one year

Recommended Control Measures

Workers should be trained to stand upwind of any dust generated

Spillage Procedures

There are no health risks associated with moving spillage with mechanical manual means.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Portland Cement

Supplier: Blue Circle Industries Plc

Internal Reference Code: C7

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Calcium Silicate (total dust) Calcium Aluminate		10mg/m^3	

DESCRIPTION OF SUBSTANCE:

Dry power delivered in 55kgs paper sacks, used to make mortar and concrete

HAZARDS:

Wet mortar releases strong alkalis which can cause severe skin burns and damage to the eyes. Prolonged contact with skin can cause dermatitis.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Wash off any splashes on the skin immediately and apply a moisturising cream.
Splashes in eyes should be treated with copious amount of water, irrigate for at least 10 mins.
Seek medical advice.

STORAGE PROCEDURES:

Store in dry conditions

COSHH RISK ASSESSMENT

SUBSTANCE Portland Cement **REF. CODE** C7

DESCRIPTION OF USE:
Department/Site Construction Sites
Task

Cement is mixed dry to make mortar. Dry cement is shovelled into a cement mixer four or five timers per day. The exposure to dry cement dust is approximately fifteen minutes on each occasions the cement mixer is loaded. Wet mortar is tipped into barrows for transportation within the site.

QUANTITIES USED: Half bag per load in five/three and half mixer

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because skin contact and eye contact is avoided. Inhaling small quantities of dry cement dust does not present a significant health risk.

FURTHER ACTION REQUIRED:

Washing facilities should be provided.

Recommended Control Measures

Avoid skin and eye contact. Avoid breathing cement dust.

Spillage Procedures

Avoid inhaling dust and skin contact with wet mortar.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

Example 03 1996

ASSESSMENT: ..... DATE: .....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Carlite and Thistle Plasters

Supplier: British Gypsum Ltd

Internal Reference Code: C10

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Gypsum		10mg/m^3	
Quartz (silica)		0.3mg/m^3	
Lime (Calcium Oxide)		2mg/m^3	

DESCRIPTION OF SUBSTANCE:

White power used in 55kg bags

HAZARDS:

Prolonged exposure to concentration of Gypsum in excess of the OES may result in throat and eye irritation. Prolonged exposure to silica at concentrations in excess of OES over several years may result in the development of silicosis.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Splashes in eyes: Flood eyes with plenty of water for 10 mins.
Splashes on skin: Wash thoroughly with soap and water
Ingestion: Drink copious amounts of water. Do not induce vomiting.
Seek medical advice.

STORAGE PROCEDURES:

Store in warm dry conditions

COSHH RISK ASSESSMENT

SUBSTANCE	Carlite and Thistle Plasters	**REF. CODE**	C10

DESCRIPTION OF USE:

Department/Site Construction Sites

Task

Plaster is mixed with water on large plywood boards to produce a workable paste. This is trowelled onto walls. Once wet there is little or no exposure to dust. Exposure to dust during mixing not exceed 30 minutes.

QUANTITIES USED: 10 x 55kg bags per day

ASSESSMENT OF RISK:

Air Monitoring Results

The risk to health is not significant because the duration of exposure is short.

FURTHER ACTION REQUIRED:

The risk to health should be reassessed if exposure to plaster dust exceeds two hours.

Recommended Control Measures

Ensure good natural ventilation during mixing to reduce the airborne dust concentrations.

Spillage Procedures

Shovel into bags. Reduce dust exposure to a minimum, wearing an approved dust respirator if exposure will exceed two hours.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Plasterboard

Supplier: British Gypsum Ltd

Internal Reference Code: C11

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Gypsum Quartz (silica) (4%)		10mg/m^3 0.3mg/m^3	

DESCRIPTION OF SUBSTANCE:

Solid linerboard for nailing to batons to construct partition walls.

HAZARDS:

Prolonged exposure to concentrations of Gypsum in excess of the OES may result in throat and eye irritation. Prolonged exposure to silica at concentrations in excess of OES over several years may result in the development of silicosis.

WARNINGS:

HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

☐ ☐ ☐ ☐ ☐ ☐ ☐

FIRST AID:

Cuts and scratches should be washed thoroughly with soap and water and covered with a plaster.
Dust in eyes: Flood with water for 10 minutes.

STORAGE PROCEDURES:

Store in dry conditions

COSHH RISK ASSESSMENT

SUBSTANCE Plasterboard **REF. CODE** C11

DESCRIPTION OF USE:
Department/Site Construction Sites
Task

Plaster board is nailed to wooden batons. It may be sealed and plastered. Sawing, nailing, sanding or abrading of the boards produces dust. The exposure varies with the task. If the dust exposure exceeds one hour in duration the workers wear 3m 8800 disposable dust respirators.

QUANTITIES USED: 30 boards per day

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because the workers wear approved dust respirators to limit exposure to dust.

FURTHER ACTION REQUIRED:

None.

Recommended Control Measures

Wear approved ori-nasal dust respirators when exposure is likely to exceed two hours in any one day.

Spillage Procedures

Not applicable.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03 1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Mortar

Supplier: Prepared on Site

Internal Reference Code: C19

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Calcium Silicate (total dust) Calcium Aluminium		10/mg^3	Alkaline

DESCRIPTION OF SUBSTANCE:

Wet Viscous mixtures of portland cement, sand and waterbased resin additives.

HAZARDS:

The mixture is strong alkaline, and contact with the skin or eyes can cause severe burns/ulceration. Repeated prolonged contact can cause irritant, contact dermatitis. Some individuals may develop allergic contact dermatitis through their sensitivity to traces of chromium compounds in cement.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Wash off any splashed on the skin immediately and apply a moisturising cream. Splashed in eyes should be treated with copious amounts of water, irrigate for at least 10 mins. Seek medical advice.

STORAGE PROCEDURES:

Not applicable

COSHH RISK ASSESSMENT

SUBSTANCE Mortar **REF. CODE** C19

DESCRIPTION OF USE:
Department/Site
Task

Applied to blockwork or brickwork with trowels. Limited risk of contact with skin or eyes.

QUANTITIES USED: Variable

ASSESSMENT OF RISK:
Air Monitoring Results

No significant risk to health due to lack of skin contact.

FURTHER ACTION REQUIRED:

Maintain current working procedures. Reassess in 12 months.

Recommended Control Measures

Ensure operators are aware of the risk of burns etc, through skin contact. Gloves should be worn where skin contact is foreseeable. A supply of clean water should be available to deal with splashes.

Spillage Procedures

Shovel up

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Ready Mixed Concrete

Supplier: Tarmac Topmix

Internal Reference Code: C18

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Calcium Silicate (total dust) Calcium Aluminium		10/mg^3	Alkaline

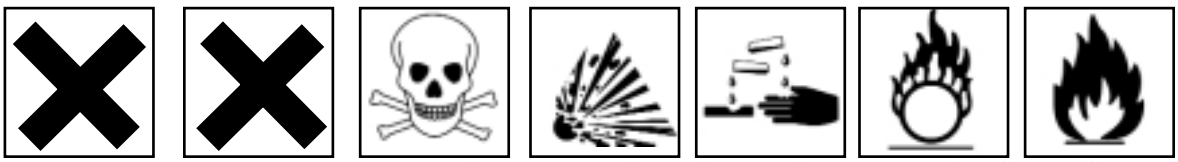
DESCRIPTION OF SUBSTANCE:

Wet Viscous mixtures of portland cement, aggregate, sand and water.

HAZARDS:

The mixture is strong alkaline, and contact with the skin or eyes can cause severe burns/ulceration. Repeated prolonged contact can cause irritant, contact dermatitis. Some individuals may develop allergic contact dermatitis through their sensitivity to traces of chromium compounds in cement.

WARNINGS:



HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

☐ ☐ ☐ ☐ ☐ ☐ ☐

FIRST AID:

Wash off any splashed on the skin immediately and apply a moisturising cream. Splashed in eyes should be treated with copious amounts of water, irrigate for at least 10 mins. Seek medical advice.

STORAGE PROCEDURES:

Not applicable

COSHH RISK ASSESSMENT

SUBSTANCE Ready Mixed Concrete **REF. CODE** C18

DESCRIPTION OF USE:
Department/Site
Task

Concrete is brought to the site by lorry and discharged directly into foundation trenches etc or into dumper trucks. The poured mix is settled with a vibrator or tamper. The operators wear rubber boots and gloves.

QUANTITIES USED: Variable

ASSESSMENT OF RISK:
Air Monitoring Results

No significant risk to health since skin contact is minimised by protective clothing.

FURTHER ACTION REQUIRED:

Maintain current procedures. Ensure supply of clean water is available to deal with splashes. Reassess in 12 months.

Recommended Control Measures

Ensure operators are aware of the risk of burns etc through skin contact. Operators must wear impervious boots, gloves and where large quantities are being poured gaiters. Eye protection should be worn where there is an obvious risk of splashing.

Spillage Procedures

Shovel up

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Fireclay Bricks

Supplier: Butterly Brick Ltd

Internal Reference Code: C15

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Silica Total Inhalable Dust Respirable Dust		 0.3mg/m^3 0.1mg/m^3	

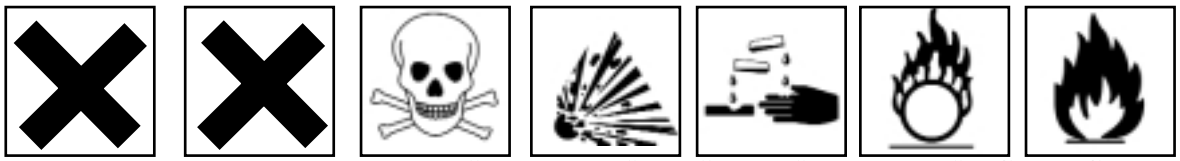
DESCRIPTION OF SUBSTANCE:

Fireclay bricks, solid chemically inert blocks, which may contain varying quantities of silica. Used for the construction of buildings.

HAZARDS:

Prolonged exposure to silica at concentrations in excess of the OES may over several years result in the development of silicosis.

WARNINGS:



HARMFUL	IRRITANT	TOXIC	EXPLOSIVE	CORROSIVE	OXIDISING	HIGHLY FLAMMABLE
☐	☐	☐	☐	☐	☐	☐

FIRST AID:

Cuts should be washed thoroughly and covered before bricks are handled

STORAGE PROCEDURES:

No special storage requirements

COSHH RISK ASSESSMENT

SUBSTANCE Fireclay Bricks **REF. CODE** C15

DESCRIPTION OF USE:
Department/Site Construction Sites
Task

Bricks are delivered on pallets and manually handled on site using barrows and hods. Individual bricks and manually handled by bricklayers wearing gloves.

QUANTITIES USED: Up to 500 per day

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health from the inhalation of silica is not significant because silica is not released as an airborne dust. The risk to health from physical skin abrasion is not significant because the brick layers wear gloves.

FURTHER ACTION REQUIRED:

If a substantial number of bricks are crushed or disc cut in a manner which exposes operators to dust over several days the risk to health should be reassessed.

Recommended Control Measures

Gloves should be worn to prevent skin abrasion.

Spillage Procedures

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Kerosene (Paraffin)

Supplier: Esso Petroleum Company Ltd

Internal Reference Code: 01

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Complex mixture hydrocarbons		100 ppm (8hr) 5mg/m^3 (8hr)	Total hydrocarbon Oil Mist

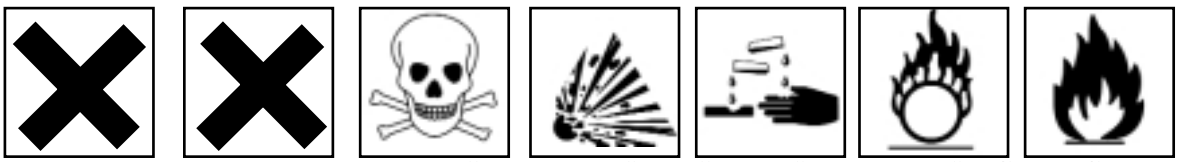
DESCRIPTION OF SUBSTANCE:

Clear liquid with characteristic petroleum hydrocarbon odour insoluble in water. Supplied in closed containers between 5 litre cans and 205 litre drums.

HAZARDS:

Inhalation of vapour and fumes at concentration above the OES in high temperature, poorly ventilated conditions can give rise to acute effects. Protracted skin contact with the liquid can lead to irritation and cause dermatitis. The formation of sprays, mist or vapour can constitute a fire/explosion hazard as well as a health hazard. Exposure to high concentrations of vapour or mist can cause irritation of eyes and respiratory tract.

WARNINGS:



HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

FIRST AID:

Inhalation:	Remove to fresh air, seek medical help
Splashes in eyes:	Flood eye with plenty of water for 10 mins
Splashes on body:	Flood splashed surface with plenty of running water for 10 mins. Remove contaminated clothing.
Ingestion:	Drink copious amounts of water. Do not induce vomiting.

Seek medical advice.

STORAGE PROCEDURES:

Keep in original containers away from sources of ignition in a well ventilated area.

COSHH RISK ASSESSMENT

SUBSTANCE Kerosene (Paraffin) **REF. CODE** 01

DESCRIPTION OF USE:
Department/Site Site Offices
Task

Used as a fuel and occasionally used as a cleaning solvent.

The drum is fitted with a tap and stored horizontally. The Kerosene is poured directly into smaller containers for filling other appliances. The drum is located in the yard.

QUANTITIES USED: 1 x 205 litre drum per month

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because the handling procedures limit inhalation and skin contact.

FURTHER ACTION REQUIRED:

Review assessment in one year.

Recommended Control Measures

Avoid inhalation of vapour or mist. Use adequate ventilation. Avoid frequent or prolonged skin contact. Do not transfer to unsuitable, unlabelled or incorrectly labelled containers. Eliminate sources of ignition.

Spillage Procedures

Eliminate sources of ignition. Contain spillage with booms or sand or other suitable absorbents and remove mechanically to containers for approved disposal. Prevent spillage reaching drains or water courses.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Motor Gasoline (Petrol) - Leaded

Supplier: Fina Petroleum Company Ltd

Internal Reference Code: 02

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Benzene (0-5% by volume)		10ppm	under review
n-Hexane (0-2% by volume)		100ppm	
Lead Alkyls (TEL 0.05-0.015 mgPb/litre		0.01mg/m^3	
(TML 0.05-0.015 mg/Pb/litre		0.15mg/m^3	

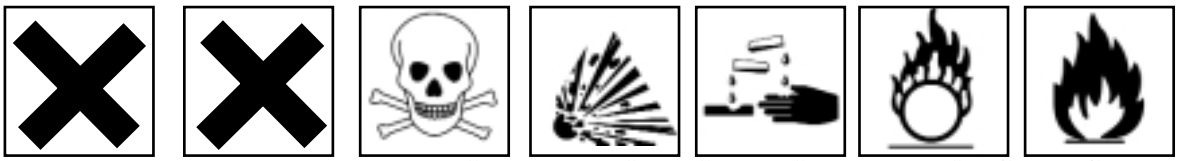
DESCRIPTION OF SUBSTANCE:

Clear yellow liquid with characteristic petroleum hydrocarbon odour. Insoluble in water. Classified as a "Special waste" under the Control of Pollution Regulations 1980.

HAZARDS:

High vapour concentrations are narcotic and may cause unconsciousness or death. Repeated exposure under conditions of improper handling could cause delayed harmful effects from some components. Storage tanks which have contained leaded petrol may contain hazardous levels of lead alkyls and the Control of Lead at Work Regulations apply to work with such tanks.

WARNINGS:



HARMFUL	IRRITANT	TOXIC	EXPLOSIVE	CORROSIVE	OXIDISING	HIGHLY FLAMMABLE
☐	☐	☐	☐	☐	☐	☐

FIRST AID:

Inhalation:	Remove to fresh air, seek medical help
Splashes in eyes:	Flood eye with plenty of water for 10 mins
Splashes on body:	Flood splashed surface with plenty of running water for 10 mins. Remove contaminated clothing.
Ingestion:	Drink copious amounts of water. Do not induce vomiting.

Seek medical advice.

STORAGE PROCEDURES:

This product is defined as "petroleum spirit" within the Petroleum Consolidation Act 1928, specifying that no more than 3 gallons may be kept without a license.

COSHH RISK ASSESSMENT

SUBSTANCE Petrol (Leaded) **REF. CODE** 02

DESCRIPTION OF USE:
Department/Site Garage/Workshop
Task

Fuel for vehicles, generators, chain saws, lawnmowers etc NOT used as a solvent of cleaning fluid. The petrol is stored in a 1000 gallon bunded tank in the yard and is dispensed directly into vehicles through a metered pump. The tank is filled monthly by bulk delivery tanker.

QUANTITIES USED: 500 gallons delivery monthly.

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because inhalation of vapour and skin contact is limited.

FURTHER ACTION REQUIRED:

Review assessment in one year.

Recommended Control Measures

Avoid inhalation of vapour or mist. Use adequate ventilation. Avoid frequent or prolonged skin contact. Do not transfer to unsuitable, unlabelled or incorrectly labelled containers.

Spillage Procedures

Eliminate sources of ignition. Contain spillage with booms or sand or other suitable absorbents and remove mechanically to containers for approved disposal. Prevent spillage reaching drains or water courses.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Motor Gasoline (Petrol) - Unleaded

Supplier: Fina Petroleum Company Ltd

Internal Reference Code: 03

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Benzene (0-5% by volume)		10ppm	under review
n-Hexane (0-2% by volume)		100ppm	
Lead Alkyls 0.13 g/Pb Litre TEL		0.01mg/m^3	
TML		0.15mg/m^3	

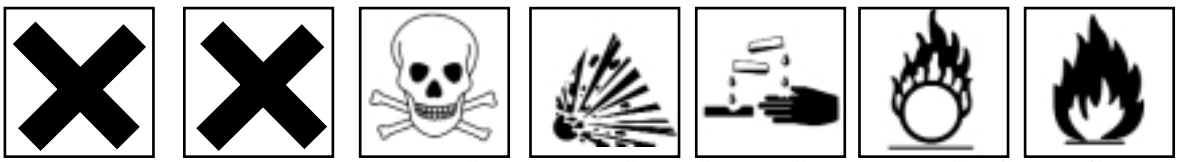
DESCRIPTION OF SUBSTANCE:

Clear yellow liquid with characteristic petroleum hydrocarbon odour. Insoluble in water. Classified as a "Special waste" under the Control of Pollution Regulations 1980.

HAZARDS:

High vapour concentrations are narcotic and may cause unconsciousness or death. Repeated exposure under conditions of improper handling could cause delayed harmful effects from some components.

WARNINGS:



HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

FIRST AID:

Inhalation:	Remove to fresh air, seek medical help
Splashes in eyes:	Flood eye with plenty of water for 10 mins
Splashes on body:	Flood splashed surface with plenty of running water for 10 mins. Remove contaminated clothing.
Ingestion:	Drink copious amounts of water. Do not induce vomiting.

Seek medical advice.

STORAGE PROCEDURES:

This product is defined as "petroleum spirit" within the Petroleum Consolidation Act 1928, specifying that no more than 3 gallons may be kept without a license.

COSHH RISK ASSESSMENT

SUBSTANCE Petrol (Unleaded) **REF. CODE** 03

DESCRIPTION OF USE:
Department/Site Garage/Workshop
Task

Fuel for vehicles designed or modified to run on unleaded petrol. The petrol is stored in a 1000 gallon bunded tank in the yard and is dispensed directly into vehicles through a metered pump. The tank is filled every two months by a bulk delivery tanker.

QUANTITIES USED: 1000 gallons delivery 2 monthly

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because inhalation of vapour and skin contact is limited.

FURTHER ACTION REQUIRED:

Review assessment in one year.

Recommended Control Measures

Avoid inhalation of vapour or mist. Use adequate ventilation. Avoid frequent or prolonged skin contact. Do not transfer to unsuitable, unlabelled or incorrectly labelled containers. Avoid malpractice such as siphoning, sniffing, use as solvent etc.

Spillage Procedures

Eliminate sources of ignition. Contain spillage with booms or sand or other suitable absorbents and remove mechanically to containers for approved disposal. Prevent spillage reaching drains or water courses. Seek expert guidance on recovery/clean up procedures from local authority.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03 1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Diesel Fuel / Gas Oil

Supplier: Total Petroleum Company Ltd

Internal Reference Code: 04

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Complex mixture of hydrocarbons		100ppm 5mg/m^3 oil mist (8 hr TWA)	Total hydrocarbons

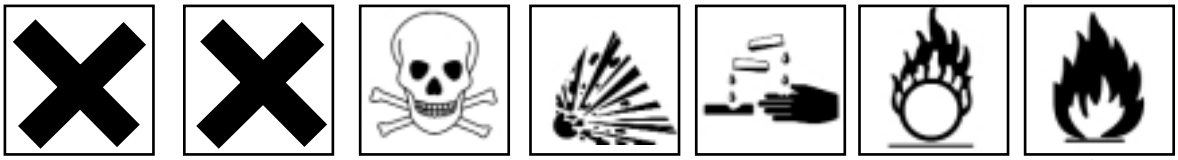
DESCRIPTION OF SUBSTANCE:

Clear yellowish liquid with characteristic petroleum hydrocarbon odour insoluble in water. Supplied in closed 205 litre drums.

HAZARDS:

High vapour concentrations are narcotic and may cause unconsciousness or death. Repeated exposure under conditions of improper handling could cause delayed harmful effects from some components.
Storage tanks which have contained leaded petrol may contain hazardous levels of lead alkyls and the Control of Lead at Work Regulations apply to work with such tanks.

WARNINGS:



HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

☐ ☐ ☐ ☐ ☐ ☐ ☐

FIRST AID:

Inhalation:	Remove to fresh air, seek medical help
Splashes in eyes:	Flood eye with plenty of water for 10 mins
Splashes on body:	Flood splashed surface with plenty of running water for 10 mins. Remove contaminated clothing.
Ingestion:	Drink copious amounts of water. Do not induce vomiting.

Seek medical advice.

STORAGE PROCEDURES:

Store in cool well ventilated area, away from heat sources and open flames.

COSHH RISK ASSESSMENT

SUBSTANCE Diesel fuel/gas oil **REF. CODE** 04

DESCRIPTION OF USE:
Department/Site Garage/Workshop
Task

Fuel for generators. The drums of diesel are held horizontal on trestles after a tap has been inserted into the screw thread. The fuel is then transferred to labelled five litre cans using a large funnel. Two of these cans are taken to each site each day to fuel the generators. When filling the cans, operatives wear rubber gauntlets and wellingtons.

QUANTITIES USED: 1 x 205 litre drums per week

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because skin contact is avoided and good person hygiene is practiced.

FURTHER ACTION REQUIRED:

Review assessment in one year.

Recommended Control Measures

Avoid prolonged inhalation of vapour/mist, use adequate ventilation. Avoid frequent or prolonged skin contact and wearing of clothing or footwear soaked in oil. Do not transfer to unsuitable, unlabelled or incorrectly labelled containers.

Spillage Procedures

Eliminate sources of ignition. Contain spillage with booms or sand or other suitable absorbents and remove mechanically to container for approved disposal. Prevent spillage reaching drains of water courses.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Propane

Supplier: British Oxygen Company

Internal Reference Code: C12

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Propane			Propane is an asphyxiant gas

DESCRIPTION OF SUBSTANCE:

Propane gas, used as a fuel gas and delivered in steel cylinders.

HAZARDS:

Propane is a highly flammable esphyxiant gas. A major leak may displace a significant proportion of the available air and result in death by asphyxiation. If there is a source of ignition fire or explosion may occur.

WARNINGS:

HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

FIRST AID:

Remove to fresh air. If breathing has stopped apply artificial respirator. Seek medical advice immediately.

STORAGE PROCEDURES:

Store in accordance with the highly flammable liquids and liquified petroleum gases regulations.

COSHH RISK ASSESSMENT

SUBSTANCE Propane **REF. CODE** C12

DESCRIPTION OF USE:
Department/Site Construction Site
Task

Five cylinders stored on site in custom built flammable gases cylinder enclosure. Two cylinders are in use as a fuel gas for site office heaters.

QUANTITIES USED: 2 cylinders per week

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant because the correct procedures are used for the connection and disconnection of cylinders. The equipment is properly maintained.

FURTHER ACTION REQUIRED:

None

Recommended Control Measures

Regular inspection of heaters, hoses, connections and cylinders.

Spillage Procedures

In the event of leaks extinguish or disconnect all sources of ignition, open doors and windows and isolate gas supply.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: White Spirit

Supplier: Langlow Products Ltd

Internal Reference Code: S9

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
White Spirit		100 ppm	

DESCRIPTION OF SUBSTANCE:

A petroleum hydrocarbon - (C9 - C10 Aliphatic/Aromatic)
A clear liquid used as a general solvent and paint brush cleaner.

HAZARDS:

Exposure to concentrations of white spirit in excess of the OEL may result in headaches, nausea or dizziness. Mildly irritating to skin and eyes.

WARNINGS:

HARMFUL IRRITANT TOXIC EXPLOSIVE CORROSIVE OXIDISING HIGHLY FLAMMABLE

FIRST AID:

Inhalation:	Remove to fresh air, seek medical help
Splashes in eyes:	Flood eye with plenty of water for 10 mins
Splashes on skin:	Wash thoroughly with soap and water
Ingestion:	Drink copious amounts of water. Do not induce vomiting.

Seek medical advice.

STORAGE PROCEDURES:

Store in a cool, dry well ventilated place. Keep away from sources of ignition.
No smoking. Keep out of reach of children.

COSHH RISK ASSESSMENT

SUBSTANCE White Spirit Thinners **REF. CODE**

DESCRIPTION OF USE:
Department/Site
Task

Used as a thinning medium in oil based paints such as primers, undercoats and gloss paint finishes. Also used to clean roller and brushes used in application of paints.

QUANTITIES USED: from 5-10 litres per day.

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant when working out of doors, because the airborne concentrations disperse rapidly.
When used indoors adequate ventilation should be provided by opening windows and doors to disperse the concentrations.

FURTHER ACTION REQUIRED:

Recommended Control Measures

Wash hands thoroughly before eating, drinking or smoking.

Spillage Procedures

Cover with absorbent material and place in a covered solid container. Avoid inhaling fumes. Remove to a safe outdoor location for disposal from site.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Dulux Trade High Gloss Finish Paint (painting interior surfaces)

Supplier: ICI Paints Division, Wrexham Road, Slough

Internal Reference Code: P3

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
White Spirit (solvent) Long oil modified alkyd (binder) non-lead (pigments)		100 ppm	

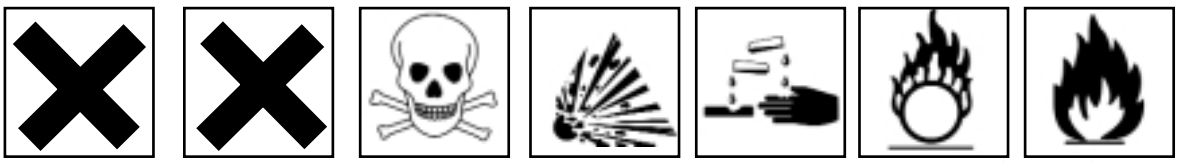
DESCRIPTION OF SUBSTANCE:

Liquid paint with distinctive odour. Delivered in 1, 2.5 and 5 litre cans.

HAZARDS:

Exposure to white spirit in concentrations in excess of the OES can lead to headaches, nausea and dizziness.

WARNINGS:



HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

FIRST AID:

Inhalation: Remove to fresh air
Splashes in eyes: Flood eye with plenty of water for 10 mins
Splashes on body: Flood splashed surface with plenty of running water for 10 minutes. Remove contaminated clothing.
Ingestion: Do not induce vomiting.
Summon medical advice.

STORAGE PROCEDURES:

Store in warm dry, conditions away from sources of ignition.

COSHH RISK ASSESSMENT

SUBSTANCE Dulux Trade Gloss Paint **REF. CODE** P3

DESCRIPTION OF USE:
Department/Site
Task

Used to paint interior wood surfaces. The paint is applied by brush in rooms 12ft by 15ft. All doors and windows are closed to prevent dust depositing on newly painted surfaces. The painters position a propane room heater in the centre of the room to assist paint drying. Exposure last for five to six hours.

QUANTITIES USED: 10 litres per day

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is significant, because the concentrations of white spirit from the drying paint will exceed the OES and the painter may suffer the signs and symptoms described overleaf.

FURTHER ACTION REQUIRED:

Doors and windows should be opened to provide adequate ventilation. For this product the minimum ventilation requirement is 707 cubic metres of air for every litre of paint applied.

Recommended Control Measures

Adequate ventilation.
Wash hands thoroughly before eating, drinking or smoking.

Spillage Procedures

Cover with absorbent material and shovel into a solid container. Avoid inhaling vapour.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Dulux Trade High Gloss Finish Paint (painting exterior surfaces)

Supplier: ICI Paints Division, Wrexham Road, Slough

Internal Reference Code: P2

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
White Spirit (solvent)		100 ppm	
Long oil modified alkyd (binder) non-lead (pigments)			

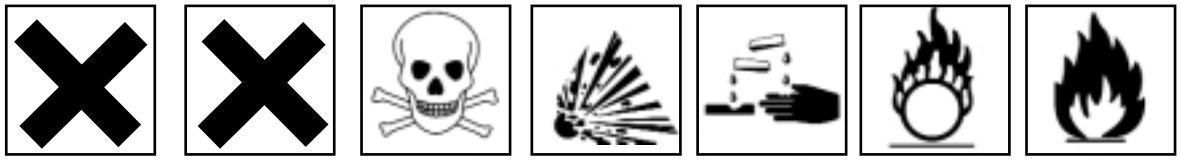
DESCRIPTION OF SUBSTANCE:

Liquid paint with distinctive odour. Delivered in 1, 2.5 and 5 litre cans.

HAZARDS:

Exposure to white spirit in concentrations in excess of the OES can lead to headaches, nausea and dizziness.

WARNINGS:



HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

☐ ☐ ☐ ☐ ☐ ☐ ☐

FIRST AID:

Inhalation: Remove to fresh air
Splashes in eyes: Flood eye with plenty of water for 10 mins
Splashes on body: Flood splashed surface with plenty of running water for 10 minutes. Remove contaminated clothing.
Ingestion: Do not induce vomiting.
Summon medical advice.

STORAGE PROCEDURES:

Store in warm dry conditions, away from sources of ignition.

COSHH RISK ASSESSMENT

SUBSTANCE Dulux Trade Gloss Paint **REF. CODE** P2

DESCRIPTION OF USE:
Department/Site
Task

Used to paint exterior and interior wood and metal surfaces. The paint is applied evenly over the surface using a brush. Exposure lasts four to five hours per day. Brushes are cleaned using white spirit.

QUANTITIES USED: Up to 10 litres per day

ASSESSMENT OF RISK:
Air Monitoring Results

The risk to health is not significant when working out of doors because the airborne concentrations of white spirit disperses rapidly.
When used indoors adequate ventilation must be provided by the opening of windows and doors to disperse the white spirit concentrations.

FURTHER ACTION REQUIRED:

Recommended Control Measures

Wash hands thoroughly before eating, drinking or smoking.

Spillage Procedures

Cover with absorbent material and shovel into a solid container.
Avoid inhaling vapour.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Dulux Trade Undercoat

Supplier: ICI Paints Division, Slough

Internal Reference Code: P6

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
White Spirit (solvent) oil modified alkyd resin non-lead (pigments)		100 ppm	

DESCRIPTION OF SUBSTANCE:

Liquid paint supplied in 1, 2.5 and 5 litre cans.

HAZARDS:

Exposure to white spirit vapour in concentrations in excess of the OES can cause headaches, nausea and dizziness. Splashed in the eyes will cause irritation and possible damage. Prolonged contact with the skin may have a defatting effect which may lead to irritation and sometimes dermatitis.

WARNINGS:

HARMFUL IRRITANT TOXIC EXPLOSIVE CORROSIVE OXIDISING HIGHLY FLAMMABLE

FIRST AID:

Inhalation:	Remove to fresh air, seek medical help
Eyes:	Wash eye with water for at least 10 mins, seek medical help
Skin:	Wash wish proprietory skin cleaner/soap with water
Ingestion:	Do not induce vomiting, summon medical help

STORAGE PROCEDURES:

Store in cool dry, well ventilated area away from sources of ignition.

COSHH RISK ASSESSMENT

SUBSTANCE Dulux Trade Undercoat **REF. CODE** P6

DESCRIPTION OF USE:
Department/Site
Task

Applied by brush to interior and exterior woodwork. Open doors and open or unglazed windows, ensure good ventilation in the area of use.

QUANTITIES USED:

ASSESSMENT OF RISK:
Air Monitoring Results

No significant risk to health since usage is in well ventilated area and skin contact is negligible.

FURTHER ACTION REQUIRED:

Maintain current working procedures. Reassess in 12 months.

Recommended Control Measures

Use with adequate ventilation of painting indoors. Avoid excessive and prolonged skin contact. Wear eye protection if there is a risk of splashing.

Spillage Procedures

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Dulux Trade Vinyl Silk

Supplier: ICI Paints

Internal Reference Code: P11

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
None			

DESCRIPTION OF SUBSTANCE:

White or coloured suspension of non toxic pigments in water.

HAZARDS:

Splashes in the eye will cause irritation. Prolonged contact with the skin may cause irritation. Accidental swallowing may cause irritation and disturbance of the digestive system.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Eye:	Wash with clean water for at least 10 minutes. Any contact lenses must be removed.
Skin:	Wash with soap and water or a proprietary skin cleanser
Swallowing:	Do not induce vomiting – seek medical help

STORAGE PROCEDURES:

Store in a cool, dry place

COSHH RISK ASSESSMENT

SUBSTANCE Dulux Trade Vinyl Silk **REF. CODE** P11

DESCRIPTION OF USE:
Department/Site Greenbridge Site
Task

Applied by brush or roller to walls and ceiling under reasonable ventilation conditions. Painter wears overalls and has little skin contact with the paint. Brushes and rollers washed by hand with water at regular intervals. Good hand washing facilities available.

QUANTITIES USED: Variable

ASSESSMENT OF RISK:
Air Monitoring Results

No significant risk to health since the method of use minimises the risk of skin contact

FURTHER ACTION REQUIRED:

Review assessment in one year's time

Recommended Control Measures

Minimise skin contact. Maintain good standards of personal hygiene.

Spillage Procedures

Absorb with sponge or cloth. Wash surface and absorbing material with water.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Dulux Trade Vinyl Matt

Supplier: ICI Paints

Internal Reference Code: P12

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
None			

DESCRIPTION OF SUBSTANCE:

White or coloured suspension of non toxic pigments in water.

HAZARDS:

Splashes in the eye will cause irritation. Prolonged contact with the skin may cause irritation. Accidental swallowing may cause irritation and disturbance of the digestive system.

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Eye:	Wash with clean water for at least 10 minutes. Any contact lenses must be removed.
Skin:	Wash with soap and water or a proprietary skin cleanser
Swallowing:	Do not induce vomiting – seek medical help

STORAGE PROCEDURES:

Store in a cool, dry place

COSHH RISK ASSESSMENT

SUBSTANCE Dulux Trade Vinyl Matt **REF. CODE** P12

DESCRIPTION OF USE:
Department/Site Greenbridge Site
Task

Applied by brush or roller to walls and ceilings under reasonable ventilation conditions. Painter wears overalls and has little skin contact with the paint. Brushes and rollers washed by hand with water at regular intervals. Good hand washing facilities available.

QUANTITIES USED: Variable

ASSESSMENT OF RISK:
Air Monitoring Results

No significant risk to health since the method of use minimises the risk of skin contact

FURTHER ACTION REQUIRED:

Review assessment in one year's time

Recommended Control Measures

Minimise skin contact. Maintain good standards of personal hygiene.

Spillage Procedures

Absorb with sponge or cloth. Wash surface and absorbing material with water.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Tanalith Treated Timber (Dry)

Supplier: Hickson Timber Products Ltd

Internal Reference Code: C1

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Sodium dichromate Cr (VI)		0.05	
Arsenic pentoxide as As	0.2		
Copper sulphate	-	-	
	mg/m³	mg/m³	

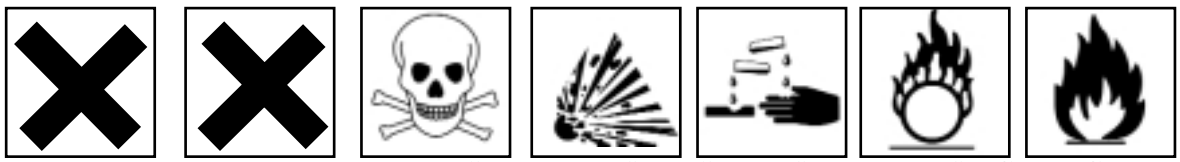
DESCRIPTION OF SUBSTANCE:

Dry timber treated with tanalith wood preservative which contains copper, chromium and arsenate (CCA) as the active ingredients.

HAZARDS:

Although tanlised timber contains toxic chemicals, these are chemically bound to the wood and will not affect persons handling the timber. Inhalations of tanalised wood dust at concentrations above the MEL/OES may cause headache, shortness of breath and lung congestion. Eye contact may cause irritation.

WARNINGS:



HARMFUL	IRRITANT	TOXIC	EXPLOSIVE	CORROSIVE	OXIDISING	HIGHLY FLAMMABLE

FIRST AID:

Inhalation:	Remove to fresh air, summon medical help and explain that exposure was to the substances listed above
Eyes:	Wash with water for 10 mins, seek medical help
Skin:	Wash with soap and water

STORAGE PROCEDURES:

As for treated wood

COSHH RISK ASSESSMENT

SUBSTANCE Tanalith Treated Timber (Dry) **REF. CODE** C1

DESCRIPTION OF USE:
Department/Site Construction Sites
Task

Handling and hand cutting treated timber on site.
Timber used for rafters, joists, purlins, wall plates, shingles, tile batons, sarking, floor joists, floor boards, ledged, braced and battened doors for our buildings and garages.Fascia boards, soffit boards, barge boards, fencing.

QUANTITIES USED: Continuous use

ASSESSMENT OF RISK:
Air Monitoring Results

The risk from handling and manual cross cutting of dry treated timber is not significant since the quantity of wood dust generated will not cause the MEL/OES to be exceeded.

FURTHER ACTION REQUIRED:

Maintain current working procedures. Review this assessment if power tool cutting of tanalised wood is necessary, or in 12 months time.

Recommended Control Measures

Avoid power cutting or sanding operations. Maintain good standards of personal hygiene and keep any cuts covered with waterproof plasters.

Spillage Procedures

Small quantities of unwanted timber or shavings may be burnt in an open area and the ashes buried. Larger quantities should be taken to a landfill tip.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Sadolin Classic Woodstain

Supplier: Sadolin

Internal Reference Code: P14

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
White Spirit Dichlofluanid (fungicide)		100 ppm	Moderately toxic by skin absorption

DESCRIPTION OF SUBSTANCE:

A solution of a dye and a fungicide in white spirit used to colour and preserve wood

HAZARDS:

Inhalation of white spirit vapour at concentrations in air in excess of the OES will cause headaches, nausea or dizziness. The liquid will irritate the skin and eyes. Prolonged skin contact may cause gastric disturbances through absorption of the fungicide

WARNINGS:

HARMFUL | IRRITANT | TOXIC | EXPLOSIVE | CORROSIVE | OXIDISING | HIGHLY FLAMMABLE

☐ ☐ ☐ ☐ ☐ ☐ ☐

FIRST AID:

Inhalation:	Remove to fresh air, if symptoms persist seek medical advice
Splashes in eyes:	Wash for at least 15 minutes with clean water, seek medical advice
Skin:	Wash well with soap and water
Swallowing:	Wash mouth with water, seek medical advice

STORAGE PROCEDURES:

Store securely in a cool dry place

COSHH RISK ASSESSMENT

SUBSTANCE Sodium Classic Wood Stain **REF. CODE** P14

DESCRIPTION OF USE:
Department/Site Bridge House
Task

The liquid is applied by brush to small areas of external woodwork. Use is at very infrequent intervals. Gloves are not worn.

QUANTITIES USED: Very small

ASSESSMENT OF RISK:
Air Monitoring Results

No significant risk to health since very small quantities are used, very infrequently and under conditions of good ventilation.

FURTHER ACTION REQUIRED:

Introduce the wearing of gloves for all painting activities involving fungicides, and eye protection where splashing is likely. Review this assessment if ????????? or of indoor usage is necessary.

Recommended Control Measures

Avoid skin and eye contact by wearing gloves, and eye protection if splashing is likely. Use under conditions of good ventilation.

Spillage Procedures

Wear gloves, absorb in granules or rags. Place in skip.

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Rockwool Insulation

Supplier: Rockwool

Internal Reference Code: C20

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Man made mineral fibre	5mg/m^3 (8hr)		

DESCRIPTION OF SUBSTANCE:

Friable fibrous material used for general insulating purposes usually supplied in wrapped rolls. Airborne fibre levels generated during laying of insulations in poorly ventilated areas may exceed MEL.

HAZARDS:

The main risk to health from mineral fibre is through inhalation or airborne fibres. The particles will irritate skin and eyes and excessively dusty conditions will irritate the upper respiratory tract. There is concern about the long term effects of inhalation of fine fibres and studies have shown an excess of lung cancers in early rockwool production workers.

WARNINGS:


HARMFUL ☐


IRRITANT ☐


TOXIC ☐


EXPLOSIVE ☐


CORROSIVE ☐


OXIDISING ☐


HIGHLY FLAMMABLE ☐

FIRST AID:

Skin – Skin should be rinsed thoroughly under running water before the application of soap to prevent fibres being rubbed in to the skin

Eyes – Flush copiously with water. Seek medical attention if irritation persists.

STORAGE PROCEDURES:

No special requirements

COSHH RISK ASSESSMENT

SUBSTANCE Rockwool Insulation **REF. CODE** C20

DESCRIPTION OF USE:
Department/Site
Task

Rolls are unwrapped and placed between the ceiling joists. The loft area is poorly ventilated. The laggers wear overalls, but no form of respiratory protection.

QUANTITIES USED: Substantial quantities on a daily basis.

ASSESSMENT OF RISK:
Air Monitoring Results

Measurements of airborne fibre concentrations would be needed before compliance or otherwise with the MEL could be demonstrated. However, exposure to fibres is clearly not being reduced so far as is reasonably practicable, and is thus not adequately controlled.

FURTHER ACTION REQUIRED:

Introduce improved working procedures as soon as possible and then review this assessment.

Recommended Control Measures

Ventilation should be maximised. Approved dust respirators must be worn along with goggles, gloves and loose overalls. Operatives should be trained in the use and maintenance of respirators and workers should be familiar with HSE Guidance Note EH46 'Exposure to Mineral Wool'

Spillage Procedures

Not applicable

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Fibreglass Insulation

Supplier: Pilkington

Internal Reference Code: C5

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Man made mineral fibre	5mg/m³ (8hr)		

DESCRIPTION OF SUBSTANCE:

Friable fibrous material used for general insulating purposes usually supplied in wrapped rolls. Airborne fibre levels generated during laying of insulation in poorly ventilated areas may exceed MEL.

HAZARDS:

The main risk to health from mineral fibre is through inhalation or airborne fibres. The particles will irritate skin and eyes and excessively dusty conditions will irritate the upper respiratory tract. There is concern about the long term effects of inhalation of fine fibres and studies have shown an excess of lung cancers in early rockwool production workers.

WARNINGS:


HARMFUL ☐


IRRITANT ☐


TOXIC ☐


EXPLOSIVE ☐


CORROSIVE ☐


OXIDISING ☐


HIGHLY FLAMMABLE ☐

FIRST AID:

Skin – Skin should be rinsed thoroughly under running water before the application of soap to prevent fibres being rubbed in to the skin

Eyes – Flush copiously with water. Seek medical attention if irritation persists.

STORAGE PROCEDURES:

No special requirements

COSHH RISK ASSESSMENT

SUBSTANCE Fibreglass Insulation **REF. CODE** C5

DESCRIPTION OF USE:
Department/Site
Task

Fibreglass insulation is used in roof spaces and integral garages. The roof space work involves unrolling the insulation and placing it between rafters. This is carried out in poorly ventilated conditions. When insulating integral garages, the ventilation is good but the work involves insulation being installed above head height which increases risk of eye irritation. The workers currently wear disposable overalls but no other protective equipment.

QUANTITIES USED: Substantial quantities on a daily basis.

ASSESSMENT OF RISK:
Air Monitoring Results

The risk of inhaling glassfibre particles is significant. Eye and skin irritation is also likely. Working practices should be designed in such a way as to minimise airborne fibre release.

FURTHER ACTION REQUIRED:

Review assessment after implementation and monitoring of control measures.

Recommended Control Measures

Ventilation should be maximised. Approved dust respirators must be worn along with goggles, gloves and loose overalls. Operatives should be trained in the use and maintenance of respirators and workers should be familiar with HSE Guidance Note EH46 'Exposure to Mineral Wool'

Spillage Procedures

Not applicable

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Example..... DATE: .....03.1996.....

COSHH HAZARD IDENTIFICATIONS

SUBSTANCE/TRADE NAME: Mild Steel Welding Fume

Supplier:

Internal Reference Code: E11

HAZARDOUS INGREDIENTS:	MEL	OES	OTHER HAZARDS
Welding Fume Fluoride Nitrogen Dioxide		5mg/m^3 2.5mg/m^3 3mg/m^3	

DESCRIPTION OF SUBSTANCE:

Fume and gases given off during manual metal arc welding of mild steel

HAZARDS:

Inhalation of fume and gas concentrations in excess of the OES may cause irritation of the respiratory system. Long term exposure may cause bone disease and lung disease (siderosis)

WARNINGS:


HARMFUL


IRRITANT


TOXIC


EXPLOSIVE


CORROSIVE


OXIDISING


HIGHLY FLAMMABLE

FIRST AID:

Persons suffering irritation of the nose, throat or lungs should be moved to fresh air and medical advice should be sought

STORAGE PROCEDURES:

COSHH RISK ASSESSMENT

SUBSTANCE Mild Steel Welding Fume **REF. CODE** E11

DESCRIPTION OF USE:

Department/Site Engineering Services Workshop

Task (Manual Metal Arc)

Mild steel welding (Manual Metal Arc) is carried out in the welding bay. Work is infrequent but is sometimes prolonged. Welding fume is removed by a recirculating fume extractions system, but this is not regularly serviced. (The above is based on information provided – it was not possible to observe the operation)

QUANTITIES USED:

ASSESSMENT OF RISK:

Air Monitoring Results

No significant risk to health due to the infrequent nature of the operation and the local extraction equipment used

FURTHER ACTION REQUIRED:

Ensure consistent use of the extraction equipment, and have it regularly tested and serviced.

Recommended Control Measures

Use local exhaust extraction equipment

Spillage Procedures

The risk assessment applies only to this product and to the uses described above. If other products are used or the use of this product changes, a new assessment must be made.

ASSESSMENT: .....Dave Carnell..... DATE: .....03 1996.....

Practical Restoration Handbook

Site Management

by
Alan Jervis

CONTENTS

1. INTRODUCTION

The author intends that this chapter will give the reader the benefit of tens of years of distilled wisdom culled from many canal restoration sites around the UK and prevent any project leader having to reinvent the wheel(barrow).

The scope of this booklet is deliberately as wide as possible. Obviously each restoration project is different and each one will require different degrees of management. The site manager may only have to deal with a few local volunteers working a few hours each weekend or an entire summer of WRG Canal Camps with intense activity every day. This booklet hopefully will give the reader clues about how to deal with either situation or anything in between. Generally it is assumed that the reader is trying to set out a medium sized project, say, restoration of a small flight of locks.

The site leader described in this booklet is so perfect that he is almost impossible to imagine. However, there have been some site leaders who have managed to achieve this perfect status and are the ideal choice to tell everyone else how to do it. But instead, I've been lumbered with doing it!

Please note that the terms "site manager" and "site leader" are not quite interchangeable in this chapter. The site manager is taken to be the person who manages the site overall and makes the decisions on how jobs will be done. The site leader is the person actually in charge on the site at any one time. Thus while it is possible for the site manager to be absent the site leader will always be present on site.

Probably the most important message to impart when thinking about how to lay out and manage your site is to think through the whole project fully before you start. Bringing in the lock gates may well be the very last item on your works schedule but you need to ensure there will be access for the wagon and crane right from day one if you are to avoid embarrassment. The logical extension of this is that you actually need to consider past completing your project and on to maintenance and possible improvements.

2. NEIGHBOURS

Consider well your neighbours in terms of noise, disturbance, etc. especially on Sunday mornings. They will rarely forgive and never forget. Noise pollution is recognised by the law these days (and cases do come to court) so if your work is close to residential housing then think before you run up that air compressor on Sunday morning. Your volunteers may well thank you for it as well. Farmers with livestock/chicken coops or similar may also be concerned by your work. Most modern plant is marked with its noise rating on the cab so you have no excuse for not knowing how loud it will be and planning appropriately. Noise at Work is difficult to measure on a construction site as there are so many contributions from various sources. However, where a volunteer is exposed to noise levels above 85dBA then hearing protection must be provided and should be worn. At levels above 90dBA hearing protection must be worn.

3. MANAGEMENT OF THE SITE

Management of a site begins long before you move on to it. The stages considered here are:

3.1 Project Planning

Your project should begin with an overview of the whole process. You should ensure that you have a clear idea of the sequencing of events. Working with volunteers will be much slower than you expect and, though you should make some attempt at a time-scale, you must be prepared for it to slip considerably, but if your pre-planning has been good, the actual sequence of operations should hold. Discuss your plan with as many experienced people as you can and modify it in the light of any sensible suggestions that you receive.

In addition it is well worth consulting the IWAs Honorary Consulting Engineers about any technical aspects of the project. Contact them via IWA Head Office.

In the author's opinion the best thing any aspiring site manager can do is go on a WRG Canal Camp on an established major restoration scheme (even if only for a couple of days). This will give you an insight not only into how to plan for a Canal Camp, but also to the complexities of getting everything in place before it is needed. Bob Kearney and Neil Ritchie both attended Canal Camps on the Montgomery and now run probably the two most respected and best organised projects in the country.

The exchange of information and experiences is the best way to avoid mistakes and the author recommends joining either the Northern or Southern Canals Association as a good step. If you can't work out whether you should join the NCA or the SCA then perhaps leading a canal restoration is not for you.

Planning is a 'top-down' sequence of events: start with the general picture and then work down the levels of detail. At the top level will come most of the statutory considerations: planning permissions, negotiations and agreements with the navigation authority, landowners etc. It cannot be stressed enough that these permissions take forever to obtain. Even the most simple scheme, with no "implications, issues or knock ons" can disappear in a muddle of red tape so plan ahead to ensure you have the permissions on paper when your volunteers turn up.

For each major phase of the project, you may well require CDM plans, architect's/engineering drawings, Health and Safety and COSHH assessments, bills of quantity etc. See PRH "Health & Safety Sections 1-4" for further guidance.

It is also essential for all but the smallest repair to undertake both a heritage survey and an environmental survey. Involve all the bodies that will (whether you like it or not) have a statutory responsibility (or similar influence) over your scheme. Similarly the local authorities should be consulted, particularly with

reference to local development plans, planning designations, etc. Although this may seem like entering the lions den it is important to establish a working relationship with these parties at the start. It may well be to your advantage when you discover your scheme is in a designated tourist area and qualifies for grants, for example.

Having set up the framework within which you intend to operate, you can move on to the next phase: setting out the site (or, for a large project, setting out the first phase site). But before you do there is one last thing to be done: spend half a day photographing the entire site. The author has lost count of the number of times he wished for a "before" photo to go with the "after" one he has just taken of the finished project. Now, on with the action. . .

3.2 Project Communication

This falls into two clear divisions: internal and external. It is important that you keep a flow of information to both these areas. Within your society it is important the other officers are kept abreast of developments. It is only polite to inform your Chairman of your accidental flooding of the main road before he attends that public meeting! Likewise, if there is a lull in your physical activity then tell the members why, otherwise they will only wonder and lose heart.

It will also pay to keep your publicity officer abreast of your plans. This should stop him bringing the Mayor onto site just as you pressure-wash the lock chamber and shower the entire site in silt.

Keep a record of the works done, donations received and volunteers hours spent; whoever is in charge of obtaining funding will need them as "matching funding" for future grant applications.

Don't forget the paperwork side of things: discuss how you are going to run the site with your treasurer and see what he wants, he may not be digging alongside you at the weekends but he is the one who spends Thursday evening worrying about the fact that, according to the pink slips he has, three dumpers that were delivered on Friday but two dumpers and a road roller were collected on the Monday! Also bear in mind that the site will need a budget irrespective of what works you are doing: little things like hard hats, funnels and First Aid supplies all add up and you are going to need them. A close and pleasant relationship with your treasurer is essential: he has to be able to plan ahead and know what bills are coming in. You cannot afford to have black marks against your credit accounts because even if the trade counter of your builders merchant is open on a Saturday the accounts department won't be.

Society magazines take time to produce, collate and circulate. You need to plan your working parties well in advance if you are to circulate the details. You can't be surprised at a low turnout if your working party dates are the best kept secret in town.

Remember that there are people outside your society also interested in your progress, if you have local supporters then keep them informed (that way when your local MP opens the new "Bloggs Tool and Pipe Works" he might happen to mention that you are about to start installing your backpumping scheme). It is also important to keep the wider waterway movement abreast of your works. Updates in the established waterways magazines will keep your profile up and may indeed result in surprise donations from individuals and organisations. Dave Wedd publishes a comprehensive list of all volunteer work in the UK and this is the standard reference that the IWA web pages, "navvies", the author and most of the movement refer to.

Volunteers (such as any of the WRG groups) plan their working schedule in advance; if you expect to need a big push of volunteers in autumn then best write to their magazine *navvies* in the spring so they all know and can contact you if interested. WRG Canal Camps are planned even more in advance and if you hope to host a Canal Camp one summer then best to start asking them the summer before (try at the National Waterways Festival – they're easy prey then).

3.3 Setting Up the Site

3.3.1 Layout

It may seem wasteful to spend time and effort on the temporary structure of a site compound but experience has shown that proper fencing, material bays, drainage, fuel stores, etc are good investments. To spend the first five weekends preparing a site for a few years concentrated work is not excessive.

Also worth considering is the technique of filling in the canal to gain extra ground. If you don't have enough space for a compound alongside the canal then you can fill in the canal bed temporarily. Though it may sound silly, with a large excavator and the right material it may only take a day to fill the bed and, at the end of the project, a day to reprofile it. Remember, however, to consider drainage along the bed and build in drainage pipes as appropriate.

It you are going to be on site for any length of time, pay particular attention to haul roads and plant access roads. The high cost of installing a proper haul road will be repaid surprisingly quickly if weather conditions deteriorate. 200mm of roadstone laid on a 4-metre width of geotextile will stand pounding by the heaviest plant and will not degenerate into an embarrassing quagmire.

3.3.2 Signage

This is key to an easy running site; it makes it easy if everyone from wagon deliveries to journalists, civic dignitaries to volunteers can actually find the site. It also stops them going too far and getting their wagon (or wellies) stuck.

Placement is critical; there is no point in placing a "deep drop" sign so close to the hole that people have to get close to read it, and no point in placing a "machine slew area – do not enter" if it will be knocked down every time a machine slews!

Project information signs are also beneficial. They will stop the public holding you up by asking you damn fool questions and will ensure that everybody who passes your site knows what is happening and who you are. Many donations come with letters that start "I was passing by your site and. . ."

These days funding organisations will insist on full credit and this is usually achieved by a "Partners' Board". This is the board that has the logos and details of all the parties involved – English Partnerships, English Heritage, Millennium Commission, etc. all have printed guidelines for this.

One item always raised is "Why do we have to spend all this money on fancy signs, why can't we just make some up on a bit of board?" Well of course you can and any society should be trying to recruit someone with a good eye and a steady hand for just this purpose. There are

situations where the layout of a sign is legally defined but these can still be handmade. Firms such as ARCO, Stocksigns and Seton have free catalogues with all the information on legal requirements. In addition there are now many small firms who make up each sign individually to order. The signs are created on a computer and then formed onto a plastic backing. Because each one is individual the firms often offer a customising service free of charge. Normally this is used to personalise the sign with "Wimpey Construction PLC" but if you can find a sponsor then it could equally say "project supported by Bloggs Bakeries" instead. This would help out your signage budget.

And finally, many modern computer packages (e.g. 'CorelDraw') come with a set of statutory signs as 'clip art'. These can be printed out and laminated as required – offering a cheap source of temporary signs.

3.3.3 Fences and Services

The actual boundaries of your site should be clearly marked and/or fenced, as should any "no go" bits of the site itself.

Check what services run through (or over) your site, and whether you can make use of them or whether you need to warn volunteers of their presence. Are they clearly marked?

Check whether there are any legacy problems e.g. asbestos dumping, heavy metal contamination etc. If you suspect this, consult the appropriate authorities about site precautions and disposal of spoil (see PRH "Health & Safety Section 4").

3.3.4 Building Materials

Think really carefully regarding size, placement, etc of the material stores. Material heaps should be properly constructed with a concrete base (or hand standing) – this will pay for itself with a reduction in spoiled/wasted materials. Thick plywood sheets can be used for materials heaps that will not be in place for more than a year. There should be a separate bay for each type of material you intend to store: sand, gravel, roadstone etc. Cement should be stored in a permanent structure if possible: if not, it should be well protected against damp and against theft (it is one of the more valuable materials that you will store). Ensure that cement stock is cycled i.e. that the bottom bag gets used. Note that cement, being hygroscopic, will always go off, even when stored in the nominal dry conditions of a shed or store: only by totally surrounding the cement in airtight plastic can you extend its normal lifetime.

The bays should be arranged so that the delivery wagon can easily tip into them and so that when shovelling by hand into a dumper, the prevailing wind does not blow half of it back in the shoveller's face.

Each bay should be labelled as delivery drivers aren't psychic: if the materials bay is clearly labelled "building sand only", then it does reduce the risk of brickies having to lay bricks with "40 to dust" and ensures you don't have to scrap two loads of expensive materials.

3.3.5 Fuel

Fuel stores must be placed away from other risk (see PRH "Health & Safety Section 1") and sited so that a machine can get in to refuel easily. Types of fuel must be clearly marked and fuel should be placed so that in the event of a fire elsewhere in the compound it will not catch fire.

Any portable containers should also be clearly labelled, as red diesel looks ever so much like Ribena but there the similarity stops. There should also be a clean place to store funnels, etc.

The fuel store is the sensible place to store any spill control measure you have. Apart from limiting expensive waste, spill prevention/limitation should be part of any responsible site's operations. Specialist catalogues such as Seton and the wonderfully named British Pig catalogue can give further details on such fascinating things as mop-a-booms and anti static non-return drip catchers.

3.3.6 Plant and Equipment Storage

The plant is probably the most valuable item on the site. Even if you intend to hire all your plant you will still need to store it overnight and you should plan for this. It should be stored in a compound that is secure, which has good access for offloading from transport vehicles etc. It may be the logical place to locate your fuel store and would ideally have at least limited maintenance facilities. The most successful sites have mid-week volunteers (usually retired people or similar who wish to help but don't wish to shovel all weekend) who turn up and perform maintenance and other house keeping jobs. This also keeps your site busy all the time, which is good for security. Another point to remember is that your kit may not be used for some weeks and the weather can change considerably in that time. You may want to perform any frost precautions much earlier than normal and perhaps remove batteries for a top-up charge at home.

3.3.7 Waste Disposal

A tidy site is a safe site – a simple comment but it has a lot of merit.

Waste materials should be stored and disposed of properly – it is no longer acceptable to simply wash out fuel filters in the nearest stream. Burning everything (the traditional approach to site clean-ups) may not be such a great idea. Also consider surface drainage from the site i.e. is it into the nearest stream?

Some materials cannot just be taken down the local tip. You should investigate what can be disposed of where. Consider the safe disposal of sharps such as bow saw blades. A skip on site is a bonus for everyone (except the rabbits) – it encourages everyone to keep the site clean. If your work does not warrant a skip then at least have an empty 45 gallon drum or similar.

3.3.8 Security

Consider a contact name and number on the sign board for the police etc. in case someone decides to torch your site hut etc. – but don't fasten the board to the hut! This contact should have keys for everything on site. Don't leave equipment and tools on view, etc. Permanent and semi-permanent site huts should have shutters (preferably steel) to cover all windows and plant should have steel 'riot shields' to protect its windows. Easily removed items (such as starting handles!) should be removed from all plant and any plant or equipment, which is even reasonably portable, should be locked up or chained down. All equipment should be security marked (with weld, where possible) and expensive items such as excavators etc. should be fitted with a 'Tracker'-type device to aid recovery. There is an international plant marking scheme, the author suggests a word with your local plant hire firm or crime prevention officer for further details on how it is implemented locally. When a site is working, you might even consider a 'night watchman' to save packing everything away overnight.

3.3.9 Access

Remember it is not just cars that have to get in, but delivery wagons and, most importantly, emergency vehicles. A chat with your local Emergency Services will mean not only are they aware of you but also while they are out and about cruising the highways on the long summer nights they may actually pop down and see if they can get to where they want to. It's better to find out before you need them.

A real bonus, if you have the space, is to create a holding area so that wagons etc. can pull off the highway and not hold up traffic while you deal with them. Remember that large wagons have different requirements to your trusty Morris Minor – consider attack and departure angles for trailers, wagons, low loaders etc. Good visibility is essential, so cut down hedge on entrance and exits, etc. Perhaps even consider wheel washing facilities if you have very fussy neighbours or a very muddy site.

A gate may be an essential security item but if possible give your local hire firm a spare key so they can deliver/collect at times that suit them. This arrangement has worked well on the Montgomery Canal. Also used on the Montgomery is the arrangement where to allow shared access to a compound with British Waterways, a length of chain is used with two padlocks – one BW, one WRG. This ensures both groups can access the compound.

3.3.9.1 Control of Public (rights of way/towpaths, etc.)

Check carefully what rights of way or other access rights apply to your site. You cannot allow the public to mix with a construction site and its machinery; neither can you deny them their rights of access. Local authorities and/or landowners and/or navigation authorities will provide the information you need.

You must arrange a clearly marked, safe route through your site and insist that the public keeps to it. In particular you should think about dogs and children who have a tendency to ignore safety barriers. Examples of suitable warning signs are given in Appendix 2. Obstruction of Rights of Way etc. is both illegal and guaranteed to make you unpopular with the locals.

Make a virtue out of necessity – signage is important (warning, direction and information) and perhaps it is well worth constructing a public viewing area to keep them out of the way and/or shepherd them towards your membership recruiters.

3.3.9.2 Control of Visitors

Consider having hard hats specially for visitors and a signing-in book. It makes them think they are going onto a real professional site. However, volunteers should always ensure the site leader knows who is on site.

3.3.9.3 Control of Car Parking

People will insist on driving to your site and so it is essential that you consider this. Parking should be marked and out of the way. Parking randomly on verges etc. does harm to the verge and thus your credibility. You MUST ensure that volunteers' cars do not obstruct the access or exit of emergency vehicles. Perhaps have a space dedicated to the emergency vehicle (see PRH "Health & Safety Section 2") and make sure it is parked ready to go out and everyone knows where the keys are.

3.3.10 Site Office

The site office is a real essential, be it an armoured portacabin permanently on site, a caravan brought onto site each working weekend or something smaller. (The Basingstoke appears to work out of the back of a van and the Droitwich runs out of a flight case!)

Whatever its composition the site hut should be a known point with all the facilities required. It should:

- have all the relevant health and safety arrangements (such as Health and Safety Plan)
- contain first aid facilities (determined by number of workers and complexity/danger of your work, see PRH "Health & Safety Section 2" for details)
- contain all the registers and records for the site
- offer shelter for the workers unless this is provided elsewhere
- be the centre for all site communications
- have an indication of site leader for the day
- be the "clean and dry" store for PPE (Personal Protective Equipment) and FAK (First Aid Kit)

For a long-term site, mains water and electricity supplies will make life very much easier. Since mobile phones became commonplace items, it is less important that the site hut should have a telephone (though this may still be useful).

3.3.11 Welfare

On the site there should be a shelter for your volunteers (not just from the cold and wet, hot sunshine is just as great a risk) and somewhere to dry outer clothes. Drinking water must be provided and while many volunteers are happy to go behind a bush (dangerous during a jungle bashing weekend), some are more delicate so please have some form of toilet facilities arranged.

3.3.12 Communications

Two way radios (and the disasters and chaos that they create) are, of course, one of the standing jokes of the canal restoration community but they do have their uses. Recent deregulation of the Mobile Radio rules mean that it is now much cheaper and easier to have two way radios for your site, however they are not without problems – contact John or Mike Palmer for their opinions (if you dare). Mobile phones are more prominent than ever but check whether they work reliably on your site. It is very good to have a local emergency contact person (one who will actually be in to receive the message on the days you are working). A REAL site will know its post code as these days more and more delivery firms use databases.

3.4 Operating the Site

3.4.1 Deliveries

If huge amounts of volunteer time is not to be wasted, it is essential to plan each weekend/camp in advance. This applies particularly to ordering and delivery of hired plant and of building materials. The site organiser should ensure that this is done well in advance, either personally or by delegation to a trustworthy individual. Someone must be available on site to receive deliveries at the agreed time – in their absence, materials will be tipped into the wrong bays, or

just dumped anywhere, hired plant will be left obstructing the site with the key so well hidden that no-one can find it, or simply taken back to the depot. The person accepting deliveries should be at least competent enough to know that the items being left are the correct ones, and numerate enough to ensure that the right quantities are being left! You will make your accountant/project manager very happy if delivery notes etc. are duly obtained, signed and carefully preserved for the future!

One frequent problem is that the delivery driver fails to make the Saturday morning delivery and so decides to deliver extra early on the Monday morning! Unless you make them aware that you are working through the weekend, they will assume that your site is only open till mid-day Saturday morning and so a Monday delivery is the next best thing. So when you request Saturday delivery ensure they know that you are working through the weekend and the Saturday morning delivery is essential.

If the site manager is not going to be present at all times, volunteers should be aware of the local sources of supply for equipment, material and fuel and of how to use the relevant accounts to obtain them! They have already driven a hundred miles to be there – don't expect them to fork out for bags of cement as well.

3.4.2 Volunteers

Volunteers are the life blood of the site. Their safety and comfort are essential. You must ensure that they have all had an adequate Health and Safety briefing (this should be kept up to date with new developments on site). You may wish to keep a register of volunteers on site. If you do so, volunteers should sign that they have received safety instruction and that they agree to abide by the site rules (and understand the consequences if they don't). This subject is dealt with in greater detail in PRH "Health & Safety Section 2".

It is essential that the management/leadership structure is clear in everyone's minds. This is really driven in by the safety briefing which is more than just a safety talk but an introduction to the site (and the leaders' first chance to assess the volunteer). Where there is a Health and Safety Plan then the leadership structure is laid down by that. Where there is no such formal plan then it is well worth getting your societies "council" to formally agree a leadership structure in writing/minutes/whatever. This makes it clear to the volunteer where their leadership is coming from.

Volunteers should know:

- Who is the site leader
- Who is second in command
- If there are any first aiders
- Where the emergency communication is
- Where the PPE and FAK is

The site leader should check that

- volunteers have signed in/received the H&S talk
- volunteers have been told all the items in the list above
- volunteers have clear instructions for the job
- the job is not beyond their physical (or mental!) capacity

- volunteers have skills adequate for the job
- plant operators/drivers have the necessary WRG authorisation (if applicable)

In conjunction with visiting leaders, team leaders etc. you should keep a site log. This should be a good quality hardback notebook (anything less substantial won't last the course, anything loose-leaf will ensure that the critical leaf is lost).

It should always be an addition to the H and S plan and information should not be duplicated. The site log can be used for messages to other workers:

"Bill – completed all but two of the shuttering frames, Keith"

usually followed by

"Keith – used them for firewood, Ta, Bill"

It should also be used for storing calculations on quantities, records of deliveries, phone numbers of suppliers, etc. and a host of other bits and pieces (some highlights from the Aston Locks site log are given in Appendix 3).

3.4.3 Other Workers

These days it is highly likely that you will end up working alongside paid professionals. (Contractors, Navigation Authority employees, etc.) This has led to many problems in the past with both sides blaming the other for everything from missing cement supplies to the Arab-Israeli crisis. Fortunately these days a more enlightened ethos often exists with the professionals not feeling quite so threatened by volunteers. The one piece of advice the author can give is to have absolutely everything sorted out with regard to shared facilities, access and resources before any work takes place. Ensure any critical points (esp. deadlines) are known to both parties.

3.4.4 Registers, Records and Inspections

It is strongly recommended that societies compile a register of skills that its volunteers possess. This may be officially recognised qualifications (e.g. a CITB excavator certificate) or less formal (good bricklayer).

For details of control of drivers and operators of plant see PRH "Health & Safety Section 2".

3.4.5 The Work Itself

Always plan the jobs thoroughly and think carefully about the effects of boring jobs being continuously thrust upon volunteers. Keeping up volunteers' morale and interest is a skill discussed in PRH "Leadership Skills". The best advice though is simply put yourself in their shoes; if they have cleaned bricks for the last three weekends, then put them on something new. wherever possible plan the work so that readily identifiable goals are possible (such as the reflooding of a pound or commissioning of a bridge) rather than just finishing everything together at the end of the project.

Always explain the big picture to volunteers so they understand why they are doing what they are doing.

Ensure there is clear communication about the jobs; they should know exactly what is expected of them and of any important points such as deadlines. The use of individual job specification sheets (such as in Appendix 4) requires some homework but does result in far fewer questions on site and far less chance of you having to say "What you've done is good but wrong" (this phrase copyright M Fellows).

However, strive for high standards and, if it is not good enough, then the wall must come down and be built again. Own up to your mistakes.

As site manager you are totally at the mercy of both volunteers and the weather. A depression moving down from the north can ruin your weekend (but enough about Andy Jones) so one important point is to always have standby jobs ready that are not time dependent and can come on stream at any time. Make these real jobs but ones that will both occupy the volunteers and not take up too much of your time while you are trying to fix the pump or whatever.

3.4.6 Training

Regarding training; the one thing WRG are agreed on is that nowhere near enough of it goes on. Not just bricklaying or fancy excavator driving but all the little skills: how to erect and assemble reinforcing, how to mark up a concrete pour, how to guess (estimate?) quantities (and get it right!). So, wherever possible take every opportunity to train people as you go. If the project warrants it have a day dedicated to a particular skill and get all local volunteers to come to it so that they are more useful from then on. This sort of investment pays great dividends and, contrary to popular opinion, volunteers don't come along to smash things up, the chance to rebuild something they can point to proudly is what will keep them hooked. If you know of another restoration scheme nearby with similar problems then pay them a visit to see how they do things.

3.4.7 Equipment (do you hire or buy?)

At first sight, it is often tempting to purchase common site equipment such as dumpers or even excavators. Hire fees seem expensive and the lure of a bargain priced piece of equipment can often seem irresistible. However, unless your site operates continuously for long periods of time, you should look carefully, and probably resist the temptation. To paraphrase the late Graham Palmer, we are not in the business of providing playthings for frustrated amateur plant fitters and the crucial point about site plant is that it should work.

Purchasing plant gives you the responsibility of storing it securely, maintaining it, obtaining test certificates (where applicable) and insuring it. Any equipment you can afford will be old and tired and will need a great deal of love and care to keep it operating. It will not respond gladly to long periods of idleness followed by short bursts of intensive use and is likely to reward your investment by breaking down at a crucial moment.

Hired plant, though expensive, is *somebody else's problem*. It will be more modern than anything you can afford, almost certainly better maintained and all of the potential headaches can be solved by a telephone call to the hire company (except at weekends!). Breakdowns, punctures, routine servicing, test certification and insurance (check this one carefully!) are all dealt with by the hire firm. You will be able to obtain a wider range of larger plant this way. Think carefully before splashing out on a sad fifth hand 1 tonne two-wheel drive, rear wheel

steer dumper – for the same cost you could probably hire a 3 tonne, four-wheel drive hydraulic steer dumper for several months.

3.5 Planning for each time the site is operated

As site manager, it is your responsibility to provide for the effective running of the site and the efficient use of volunteers' time (your most valuable commodity, though nominally it costs you nothing). Keeping volunteers standing around, or otherwise wasting their time on clearly pointless tasks is a sure way to make them choose a different project to support.

You can afford to leave nothing to chance, and every time the site is to be used, you need to check:

- the booking of accommodation
- the consent of other interested parties to the planned work
- the existence of all the relevant documentation (designs, plans, surveys, etc.)
- communication with any visiting site leaders
- any requested WRG equipment has been provided and is duly checked off
- the integrity of any dams, scaffolding, excavations or other works which need inspection and certification
- ensure that pumps are started well before volunteers arrive on site
- ensure that all necessary materials have been delivered to site
- ensure that all necessary plant (hired or owned) is on site and working – test it: it isn't good enough to know that it worked last week!
- all communications equipment is fully charged and operating
- that all starting handles, keys etc. are available
- drinking water/brew equipment is provided for
- all PPE and FAK is fit for use and available
- that everything that needs to be unlocked *is* unlocked

Ideally, before volunteers arrive on site, you will have discussed the job with the leader(s) and taken them down to site and walked and talked them through the whole job. If you have any doubts about the competence of visiting leaders (e.g. if they prove unable both to walk and talk), you should ensure that there is someone on site who understands the job and can modify the plan as the work progresses. But the exact chain of command should be clear and not buggered about with: there is nothing worse than having a local or old hand come along and interfere with the work plans.

4. WHAT DOES THE SITE LEADER DO WHEN THE OTHERS ARE WORKING?

David Hutchings maintained, rightly, that one of the skills of a good leader is to see when the volunteers are flagging and to know when to intervene/join in. Volunteers will either be inspired or shamed into redoubling their efforts. This notwithstanding, in general, the function of a site manager is to keep an overview of the whole site – becoming deeply involved in one job means that you aren't keeping an eye on the others – with potentially serious consequences. You will need to take a great deal of (good-natured?) teasing about your 'lack' of activity, but your job is to be everywhere, to see everything and ensure everyone is working. But don't flog them to death either.

In the words of Mr Mick Beattie "You can't manage a site from the cab of a machine". So just because you can operate the excavator don't spend all day in there.

As site manager, you should regard yourself as responsible for site safety at all times. You should have considered all the relevant safety issues (covered in PRH "Health & Safety Section 1-4") and thought them through. You should make sure that all leaders have a clear grasp of the safety issues and that they have communicated them to their volunteers. The procedure to be followed in the event of an accident should be communicated to everyone.

You should, of course, be checking to see that the work is carried out properly and according to plan, but you should also be keeping a careful eye on the safety of the volunteers, the general public and of the site as a whole. You need to ensure that:

- PPE is being worn (in an effective manner and not as a fashion accessory)
- COSHH and other directives on the safe handling of materials are being observed
- plant and equipment is being operated in a safe manner by competent operators
- volunteers are not working beyond their capacity
- proper rest breaks are being taken
- enough hot/cold drinks are being taken
- everyone eats and does not work through meal breaks
- regular checks are being carried out on the safety of coffer dams, scaffolding etc.
- the general public are being kept well away from the work – be particularly vigilant for photographers, who usually believe that they lead a charmed life and that holding a camera confers on them immunity and immortality (and often, invisibility)
- volunteers are aware of, and avoiding 'crush zones' on plant

If you find that you have any spare time, you're not doing the job thoroughly enough! And do resist the temptation to sneak off for a crafty brew or quick kip – being found in the site hut is a real crime. If you are going off then tell everyone, they need to know where you are anyway and if you have done your bit then they won't mind you going off for a drink.

5. LEAVING THE SITE UNATTENDED

5.1 Safe for the Public?

To quote Samuel Beckett "People are bloody ignorant apes". An extreme(-ish) view perhaps, but there is no doubt that, if there is any hazard on the site when you leave, a member of the public will be magically drawn to it and get into some kind of trouble. Even if there are no obvious hazards, the low cunning of the species is such that they will ingeniously create them out of seemingly innocent components.

You must take very great care to ensure that the site is left in a safe condition, whether you will simply be away overnight or are leaving for a month.

All plant must be left safe – keys/starting handles removed and placed in the "safe place", hydraulics lowered to the ground, parked safely, and preferably immobilised so that handbrakes cannot be released and the equipment pushed into embarrassing places – like a lock chamber. Blocking in items of plant with others is a good idea, as is using the buckets of excavators to immobilise dumpers etc.

The site should be fenced in an approved manner such that it is quite clear where the public are *supposed* to walk and where not. Temporary fencing should be just that – if you are on the site for a long period of time, something more lasting should be attempted. Excavations should be fenced and you should arrange around the site various blinding sights of the obvious such as 'Danger – deep excavation', ' Soft Mud', 'Keep Out', 'Deep Water' etc.

Items such as erected scaffolding should be looked over occasionally to ensure it has not been tampered with and left in a dangerous state.

Any portable tools or equipment should be removed to a place of safety and, where possible, building materials should be protected so that they can not be stolen/thrown into the canal/used to fill the fuel tanks of site plant. Remember that unattended site plant is a limitless source of spare parts for the unscrupulous. (We had an unscrupulous once but it never worked because we couldn't get the spares).

5.2 When the volunteers have gone home

It is highly likely that when you leave site it will be in failing light. Because of this it is probable that things will be missed as you pack up. So it is a great idea to have someone local to pop down the following day and check the site for mislaid tools, starting handles left on dumpers, etc. This is an excellent example of involving everyone (see next section).

When a visiting group leaves (and you weren't there to wave goodbye) then take the time to ring the leader a day or so later to discuss the work and check everything was left as it should be. You really don't want to wait until the following month to find out that the backfilling was not completed.

When a major event such as a camp finishes then a splendid touch is to send all the volunteers a thank you letter. WRG Head Office can provide a list of those who attended and their addresses. For a weekend group a letter to the leader will normally get the message across.

6. INVOLVING EVERYONE

This is an important part of a well set-up site. Not everybody who is local will wish to swan around in mud/concrete/whatever but they still have their part to play. The finest example of this is Jan Horton of the Lichfield and Hatherton Restoration who supplies the people on site with endless chocolate cake and wonderful soup. Your members may not want to go that far but a site where someone is always providing a brew in the site hut is a very well patronised one. Equally a person who is willing to spend the day chatting with the public will not only keep them out of your hair but may also recruit a few members. See also section 3.2.6 regarding midweek maintenance.

If it's the first visit from a mobile group then an encouraging appearance from the chairman and other top nobs may well be appreciated. And leaflets for the accommodation (dare we mention the idea of a (short!) slide show in the evening) will be good for the anoraks amongst them.

And on the subject of involving everyone, by all means get your publicity officer to bring journalists, photographers etc. round (a big, sexy camp is great publicity) but it is ESSENTIAL that you check with the leader first.

7. IF ANYTHING CAN GO WRONG. . .

. . .it will! This section could be subtitled 'And now for Plan B'.

7.1 Possible Problems and their Solutions

7.1.1 Supplies/Equipment/Volunteers not arriving

Always have a standby job as mentioned above in "The work itself" and just as importantly you should also be willing to learn from your misfortune. Take the time to find out why it/they didn't arrive.

7.1.2. Equipment breakdown

This is why the author says always hire the best you can afford, and have a standby source of kit and have the manual solution ready. If you are intending to mix mortar then how much effort does it take to ensure you have an 8' x 4' sheet ready for when the mixer fails and you have to mix by hand?

7.1.3 Planned work not completed

Probably the most likely problem is that the visiting group did not complete the work you were depending on. This is most likely to occur because they did not have the skills that the job needed or possibly because they did not have the numbers. This is why it is essential to communicate with the leaders of visiting groups before the visit.

7.1.4 Unexpected snags encountered

Not much you can say except it is a learning experience for all of us. And don't be too downhearted by the many calls of "Well it was obvious it was going to be a cock up, anyone could see it, plain as day". They would say that wouldn't they?

If a concrete pour or similar goes wrong then attack it straight away: while it is green it is much easier to break up than when it is fully cured. The volunteers may not be too happy about pulling down what they have just put up but they should understand.

7.1.5 Bad weather

There is really nothing that can be done except have a good standby job. The best advice for avoiding cock ups on site is be realistic. . . if it has been raining all week and your site looks like the Somme then don't hope that your two wheel drive dumper will cope.

7.1.6 Poor quality of work

Poor quality construction work should be torn down ruthlessly. No matter how much effort a volunteer has put into a job, in his heart of hearts he does not want to spend the rest of his days looking at a poorly restored bit of the nations heritage. This is where the site manager's diplomatic skills assume great importance. It is not easy to tell an individual or group who is/are proud of their skills that the work is below standard and must be re-done. Remember delay is very expensive – the longer you leave it, the harder it will be to remove. Immediate demolition may allow the recovery of some expensive materials (e.g. bricks).

8. FINISHING THE PROJECT

Most projects, when finished, actually look pretty awful. If your project planning allows for a few months to let it "green over" then the resulting before and after photos (remember them?) will be much more impressive.

9. LIFE AFTER THE WORK IS COMPLETE

The author suggests a lot of rest and putting up those kitchen shelves you have been meaning to do for the last four years. Congratulations

APPENDIX 1 – ADDRESSES

Signs

Neil Ritchie – possibly the most helpful bloke on the planet!
Contract Sign Services
The Chapel House
Sandford Road
Churchdown
Gloucester
GL3 2HD
01452 854057

Stocksigns – a very helpful, large, free catalogue
Ormside Way
Redhill
Surrey
RH1 2LG
01737 764764
www.stocksigns.com

Seton – you will never get off their mailing list!
PO Box 77
Banbury
Oxon
OX16 7LS
0800 585501
www.seton.co.uk

Glasdon Designs Ltd – high class site boards
Clitheroe Road
Brierfield
Nelson
Lancashire
BB9 5PT
01282 616221

Spill Control

New Pig Spill Products
5-9 Dunlin Court
Strathclyde Business Park
Bellshill
Lanarkshire
ML4 3NH
0800 919900

Canal Associations
Northern Canals Association
c/o Huddersfield Canal Society
239 Mossley Road
Ashton under Lyne
Lancashire
OL6 6LN
0161 339 1332

Southern Canals Association
c/o Robin Higgs
18 Barnsford Crescent
West End
Woking
GU24 9HX

Restoration Dates Listing
Dave Wedd
7 Ringwood Road
Blackwater
Camberley
Surrey
GU17 0EY

wedd@clara.net

APPENDIX 2 – SITE WARNING SIGNS

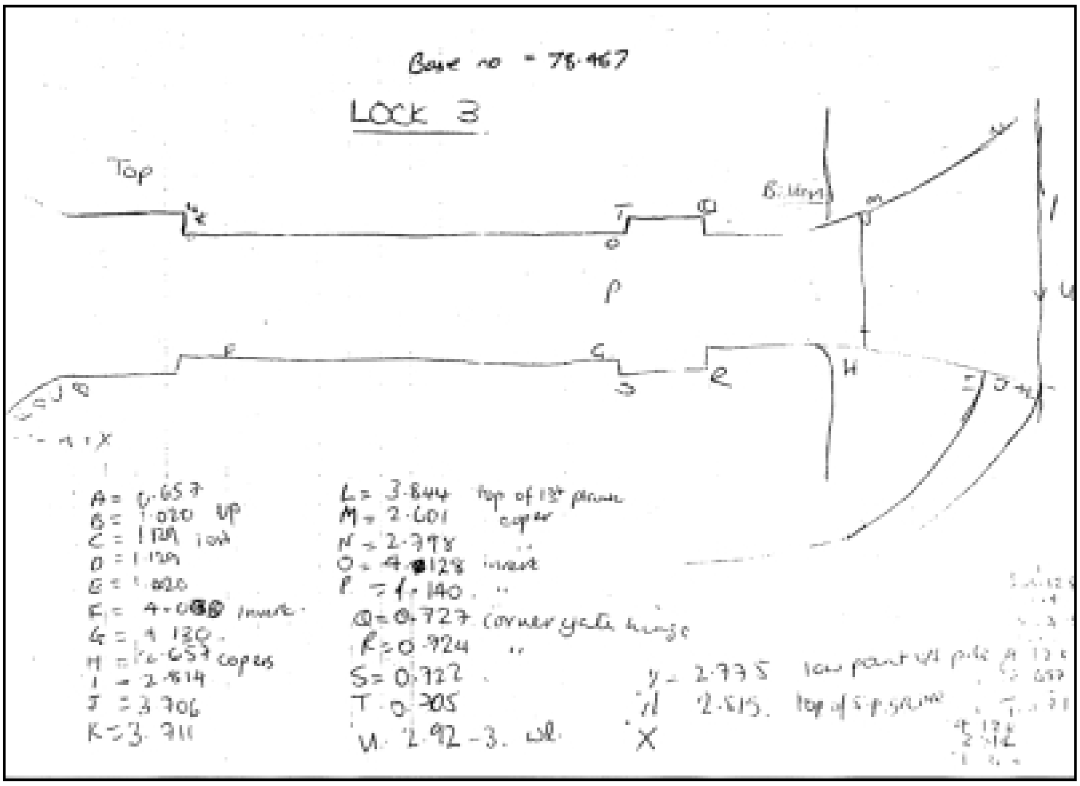
CAUTION

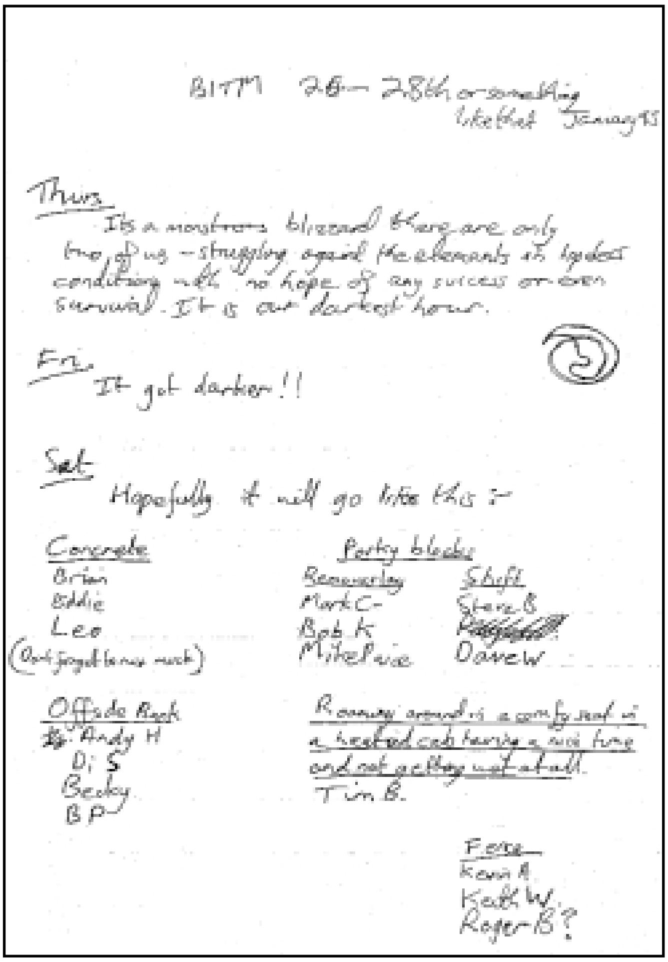
- You are approaching a work area.
- The Waterway Recovery Group are performing restoration work on this site.
- PLEASE do not pass the safety barriers and fences.
- Beware moving machinery and vehicles and ensure all drivers are aware of your presence.
- PLEASE ENSURE that ALL children and animals are under control at all times.
- Thank you for your co-operation.

CAUTION

- You are approaching a work area.
- The Waterway Recovery Group are performing restoration work on this site.
- PLEASE ENSURE that any machine operator is aware of your presence and:
- AWAIT his/her signal before you pass through his/her work area.
- PLEASE ENSURE that ALL children and animals are under control at all times.
- Thank you for your co-operation.

APPENDIX 3 – MONTGOMERY SITE LOG




BITM 26 – 28th or something like that January 95

Thurs

It's a monstrous blizzard there are only two of us – struggling against the elements in hopeless conditions with no hope of any success or even survival. It is our darkest hour.

Fri

It got darker!!

Sat

Hopefully it will go like this :–

Concrete: Brian, Eddie, Leo

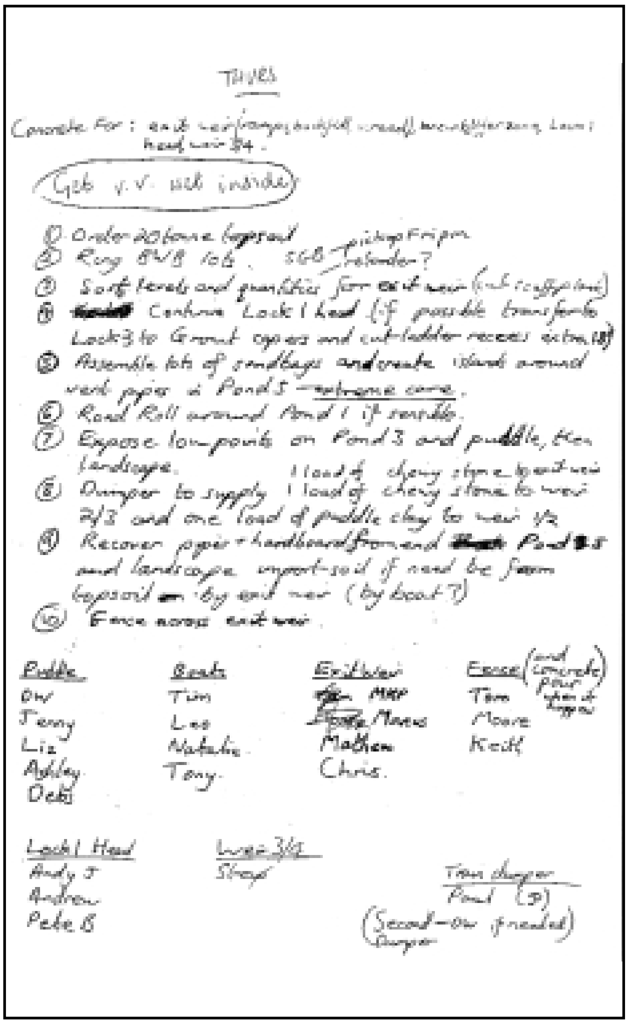
Porty blocks: Mark C, Bob K, Mike

Shift: Steve B, Dave W

Offside Bank: Andy H, Di S, Becky, B P

Roaming around in a comfy seat in a heated cab having a nice time and not getting wet at all. Tim B.

Fence: Kevin A, Keith W, Roger B?


THURS

1. Order 20 tonne topsoil
2. Ring BWB
3. Sort levels and quantities for exit weir
4. Continue Lock 1 head (if possible transfer to Lock 3 to Grout copers and cut ladder recesses extra)
5. Assemble lots of sandbags and create island around vent pipe in Pond 5 – extreme care.
6. Road Roll around Pond 1 if sensible.
7. Expose low points on Pond 3 and puddle, then landscape.
8. Dumper to supply 1 load of cherry stone to weir 2/3 and one load of puddle clay to weir 1/2
9. Recover pipe + hardboard from end Pond 5 and landscape import soil if need be from topsoil by exit weir (by boat?)
10. Fence across exit weir.

Puddle: DW, Jenny, Liz, Ashley, Debs

Boats: Tim, Leo, Natalie, Tony.

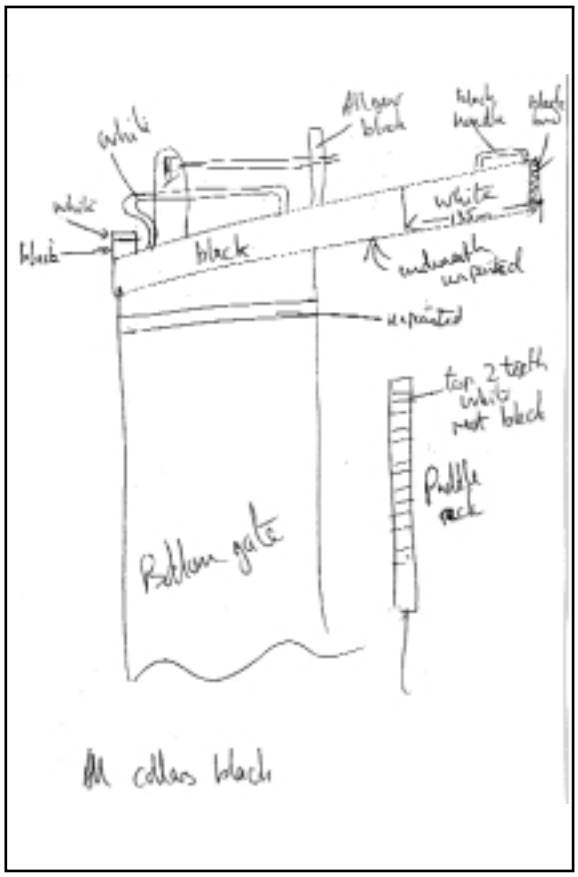
Exit Weir: Marcus, Mathew, Chris.

Fence (and concrete pour): Tom, Moore, Keith

Lock 1 Head: Andy J, Andrew, Pete B

Weir 3/4: Steve

Tim dumper, Paul (S), (Second–dw if needed) dumper



APPENDIX 4 – SAMPLE JOB SHEETS

Droitwich Junction Canal Restoration Sample Job Sheet

Job Ref: 6.2.1

Job Description: Refurbish overflow weir
Location: Head of Lock 2
Safety comments (other than follow Health and Safety Guide): Ensure safe lifting and handling of large coping bricks
Schedule/Timing: As soon as possible
Personnel requirements: 2 heavy diggers, 2 rakers/pointers, 2 coping brick layers
Equipment needed: Hawks, pointing trowels, mixer, shovels, barrows, wire brushes, plugging chisels, club hammers, spirit level

Materials: Mortar mix (5-1 but can be varied if inappropriate). It will probably need to be quite dry for seating the coping bricks on.

Details: Excavate all around the weir so that the below ground state of the existing copers can be determined. It is also necessary to drastically reduce the scrub and vegetation inherent in the surrounding ground so any roots, brambles, etc. should be removed from excavated soil and burnt. The excavated soil should be piled next to the rubble pile as shown on the diagram below. Assuming the copers look OK then the structure should be raked out fully and carefully repointed (and soft brushed 6 hours later). The upstream run of copers is missing (approximately 20 bricks) and these need to be replaced from the stack on the offside of Lock 2 flank wall. These will need cleaning. The new copers will need a fillet of concrete to support them and it may be desirable to concrete the whole of the area between the weir and the head wall to further strengthen the arch beneath. If this is done then at least 100mm ground cover must still be achieved when landscaping. All landscaping should be done using locally excavated soil that has been checked for excess roots/vegetation. Additional work is the minor raking out and pointing in the corner of the Lock 2 head wall. (Best viewed down in the pound).

Work in progress notes: Completed by WRG Canal Camp 9804 but flood testing revealed a leak in the wall of the weir as the downstream sump filled with water as the level in the pound rose. This must be remedied before the pound is returned to level.

Montgomery Canal Restoration Sample Job Sheet

Job Ref: A1

Job Description: Installation of dams and dewatering under Park Mill bridge.
Location: Park Mill bridge
Safety comments (other than follow Health and Safety Guide): Care to be taken during installation to prevent swallowing of water and hypothermia. Beware effects of lifting and twisting with heavy sandbags. Dam is to be inspected by competent person (appointed by MKP) before start of work (morning and afternoon) and after any significant change in the level. Levels either side of the dams to be monitored carefully against temporary level marks. Record of inspections to be kept in the site file for the duration of the works. At all times when personnel are present in the work area a safe method of access/egress must be available. Care must also be taken to ensure workers are not at risk during the removal of the dam.
Schedule/Timing: Before work can begin on below waterline works (probably Fri Mar 26th)
Personnel requirements: At least 5 strong people (plus 3 to support/supply)
Equipment needed: Work punt may make this job easier. Narrow spades. 3" centrifugal pump, 3" diaphragm pump.
Materials: 400 sandbags with sand to fill, 100 are already filled and stacked at Red bridge. Fuel for pumps.
Access: To be negotiated with Howard and landowners.

Details: The water level is to be lowered along the length from Maesbury to Aston using the run off sluice just south of Lock 3. The level is to be dropped by no more than 300mm. Once this has occurred the dams are to be placed either side of the bridge so that the bridge hole can be pumped out, inspected and repaired. The lower 50% of the dam must be double bag depth while the upper 50% may be single bag. Dry suits are recommended for the installation team. Once the dam is in place then the hole can be pumped dry. Careful checks must be made to ensure any leaks and weepages are sealed before work starts. The pound levels either side of the bridge are to be monitored to ensure they do not drop below the minimum marked – if so then pumping around the dams may be required. At the end of the job the dams must be completely removed so as not to cause a navigation hazard. Any fish, etc. stranded must be rescued and returned to the pound.

Work in progress notes:

Practical Restoration Handbook

Leadership Skills

by
Mick Beattie

CONTENTS

1. Over the last century many studies into leadership skills have sought the elusive definitive model of a "good leader".

2. Whether you are a ruler, head, chief, commander, director, governor, principal, captain, skipper, manager, superintendent, supervisor, overseer, foreman, kingpin, boss, number one or an innovator, pioneer, trail blazer, path finder, ground breaker or originator your role as a leader will vary according to circumstances. All the above "leaders" have in common a desire to drive and direct a group to a given end.

3. The following styles are covered in this chapter:

   - Leaders character ~ born or made?
   - Styles of leadership.
   - What makes an ideal leader?
   - The task of a leader in relation to waterway restoration.
   - Positive leadership & motivating volunteers.
   - Leaders ~ the public face of a group.
   - The relationship between leader, volunteer and governing body.

4. In the field of waterway restoration the job of the leader may be a long commitment, for example the completion of the restoration of a flight of locks or alternatively relatively short lived, for example looking after a group of first time volunteers on a Sunday afternoon. Both these leadership responsibilities are as important as each other.

Leaders ~ Born or made?

5. Before leadership roles can be understood, the leader's character needs to be examined more closely. It is often said that a good leader is born and cannot be made, that there are those who are natural followers and those who are natural leaders. To further complicate the equation there are "followers" who would, in certain circumstances, become leaders and leaders who would themselves rather follow, but find themselves thrust into leadership. Before leadership can be studied in more depth, the first task is to be able to identify potential leaders within a given group.

6. The answer to, "what makes a good leader?", is not straightforward.

7. There are no sets of rules that can be followed. There are different theories concerning leadership all of which fail individually to provide a convincing definition, but combined, conclusions can be drawn.

8. There are good leaders that can be identified with and there are bad leaders from whom important lessons can be drawn.

Trait Theories

9. If the qualities and traits that produce a "good leader", were identified and recorded, the list would be endless and by its very nature would exclude most mere mortals. There are lists in circulation that outline anything from twenty to seventeen thousand different traits. In the world of waterway restoration it could be decided that some of the most important traits would include possession of good communication skills, a sense of humour and organisational skills second to none.

10. There are great leaders involved in waterway restoration, but like leaders in other fields, some find communication a problem. They have great skill in organising, and are fun to be with but experience difficulties in their day to day dealings with people. This problem may be highlighted by different groups they are asked to lead because some groups require greater communication with the leader than others. Thus whilst communication may be paramount in one scenario in another it could almost be disregarded. The fluctuating make up of a group, which can change from day to day, or week to week, may result in problems with the leadership. Group dynamics may change leadership styles and consequently the traits that are most important and this is highlighted later.

11. It can not be concluded, however, that there are certain traits that make up a good leader and formulate a list of these. There are certain inherent skills that are common to most leaders, e.g. communication skills, knowledge of the particular task, empathy and initiative.

12. Someone should not be excluded from leadership who lacks one of these but who holds other traits. In this great care is needed when appointing leaders on their traits. Traits are important and should be borne in mind when appointing leaders, but they should not be the sole factor.

13. Hence the trait theory, when considered in isolation, is flawed.

Situation Theories

14. Good leaders are born it could also be argued that given the right set of circumstances the most suitable leader will come to light. This is known commonly as the "situation theory". If there is a job to be done and a group is assembled the likelihood is that within this group are several "born leaders", the most suitable of whom will guide the rest through the task.

15. This does happen and there are examples of volunteers achieving high standards of workmanship under the guide of a self appointed leader. However, is this an appropriate way to restore canals? Volunteers can be assembled simply enough: people will attend if the restoration project is advertised and being volunteers they will generally want to work.

16. A leader may or may not appear from within the group and keen volunteers will soon become disheartened without positive direction and clear goals. Alternatively, more than one leader may come forward, dividing the group into several parts pulling in different directions towards the same goal. This resulting divisiveness is weaker than unity, as several smaller groups may waste energy battling against each other.

Group Theories

17. The group theory considers a "leader" unnecessary, as a group of like minded people can work together as one and complete quite daunting tasks. These units can and often do, function effectively. Each member of this unit has leadership qualities; they can work on their own or as part of the group. Everyone's ideas are listened to, considered, and the best solutions to any problem followed.

18. However with voluntary labour, organisations are trying to encourage new people into canal restoration. These people will have limited experience and will need leading and in this situation the group theory starts to fall apart. Although some of the travelling groups of the Waterway Recovery Group will testify to the success of workers co-operatives, some experience difficulty in accepting new blood.

Styles of leadership

19. Different leaders can be just as effective as each other but can have wholly different styles. In looking at these the advantages and disadvantages of each style can be assessed.

Authoritarian or the "I am in charge" style of leadership

20. This style of leadership is often disregarded in the field of waterway restoration, as it is often seen as heavy handed and unnecessary when dealing with volunteers. An authority figure has the tendency to reach deep into the subconscious and make us do as we are told and people have a tendency to follow a strong leader. A group is less likely to consciously contravene an instruction given from a leader if they fear the consequences.

21. However an authoritarian who lacks the respect of the group may find himself walking the plank into the canal at the hands of mutinous volunteers, if he lacked direction and a clear mind. An authoritarian leaders' authority would soon be undermined if he kept changing his mind about what it was he wanted the group to do and how he wanted it done.

Paternalistic

22. By comparison, a "paternalistic" leader will persuade the group into accepting their decisions more readily. This style of leader adopts a paternal role . There is little doubt about who's in charge but rather than telling the volunteers what to do, the instructions are put to them in such a way that they want to do the task for the benefit of the group. There is a saying that goes along the lines that, "you get more with sugar than salt". By asking volunteers rather than telling them then the work is done more willingly and therefore it could be argued that it is more successful.

Democratic

23. This is a style of leadership that should be noted for its particular use with working volunteers as a group is more likely to achieve its set goals if the volunteers are motivated correctly. This leader is best described as a "vote taker". The whole group has a say in the tasks ahead and the leader makes a decision based upon the groups' conclusions. The leader involves everyone in the decision making process but takes an authoritative stance because at the end of the day he still makes the decisions.

24. This style of leadership often produces good results because the work force is involved and motivated and an involved work force is more productive.

25. Most people in a leadership role would listen to some but not others. There are those volunteers whose opinion and ideas are worthy and therefore more valued. There are also the first time volunteers who are "green", in that the nearest they have ever been to a construction site is passing one on the way to school! Is it a good leader or a bad leader that will listen to the latter as well as the former?

26. Consider the story of a bus stuck under a bridge. The engineers are standing by, trying to devise a solution to free the bus. A small boy, ignored by most, eventually finds an engineer who'll listen to his successful solution of letting the tyres on the bus down.

27. A good leader is one who will listen to all contributions and quickly identify those of value.

28. Leaders need to be authoritarian where authority is needed. A prime example is with regard to safety. Safety procedures have been developed over many years. They work perfectly well and therefore their interpretation is not open to debate or discussion. Waterway Recovery Group, for example, clearly state their safety policy at a special safety talk before work commences on a Canal Camp. Safety is one area where volunteers must do as they are told for their own well-being. Leaders also need to be paternalistic and manipulate the group to get the job done, in what he considers to be the best way. Finally a leader needs to be democratic, as effort and money saving ideas often originate from the least expected sources.

29. In summary, the mode of leadership to strive for should be a combination of all these styles.

30. In stating the obvious, a leader is, by definition someone who leads. However, the degree of leadership required varies depending upon the group. The job can be hard if the group are unwilling and easy if the group is like minded. It is therefore important that at the onset of a task the leader can identify the material he has to work with. A strong well experienced group should require less leadership than a team formed from generally inexperienced volunteers.

Identifying the character of the group

31. It will therefore help if leaders have some prior knowledge of the group. This can be gained in many ways: For example, with Canal Camps organised by the Waterway Recovery Group, lists of volunteers are sent to the leader in advance of the camp. These lists contain important information such as age, experience and the sex of the volunteer. Age is important, for a group of pensioners may not have the physical ability even though they have years of experience. Experience is valuable as it is an asset to be drawn upon. The sex of volunteers is relevant in considering the make up of each group and thereby ensuring that the most arduous physical tasks are completed effectively without risk to the individual.

32. Some groups, used to an authoritarian style of management may perceive a democratic leader as weak and in these circumstances this style of leadership is inappropriate.

33. A good leader will interpret all available information about the group and formulate an appropriate style of leadership.

34. Another method of ascertaining the volunteers' character might be simply to talk to them on the telephone before the camp or working party, or alternatively simply asking someone who knows them.

35. On meeting the group the leader will need to psychoanalyse the group to define its dynamics. There is no need to get each member on the couch and ask searching questions about their childhood, it is sufficient to simply observe. It is true to say that anything anyone does is done for a reason. Not all volunteers are involved with waterway restoration because of some deep rooted desire to see canals re-opened for boats. Some may be there to meet other people. Others may be there under duress, as part of a community service order or because their parents have told them to be there. Others may wish to drive heavy earth moving equipment or be taking part in the Duke of Edinburgh's' Award Scheme. Some may even want to lead the group themselves.

36. A good leader identifies all the motivations of their volunteers and sees how the mixture forms the group. Every group of people will form into a whole. This may result in a group that works well together or one that tries to pull itself apart. The leader must help the group bond well together and try to satisfy everyone's needs.

37. In considering the example of the volunteer who wishes to be a leader, there are many options open to the leader in overcoming areas of potential conflict, including oppression. A weak leader may see this type of volunteer as a threat and resort to keeping them out of harms way and away from other volunteers he may otherwise influence. Surely a better solution would be to let him lead under supervision; put him in charge of a small group, give him a title such as "Ganger" with the effect that his leadership desires are fulfilled and there is no threat to the cohesion of the group. For example this small gang could be selected to include past leaders and those who can lead but would rather take a back seat; such people would not be offended by the appointment of a "Ganger" and would simply get on with the task at hand regardless. Hence a happy medium is struck.

38. The volunteer who wants to drive the heavy earth moving machinery can be accommodated too. There may not be time or opportunity during the working day but why not take time out, during lunch or after the working day? Half an hour of driving will mean that they can go home and tell their friends about their exploits in the excavator without too much effort on the leaders part.

39. Volunteers who want to meet people are not as easily accommodated as may at first appear. Some people have a strong desire to meet others and interact with them, however some of those who use voluntary waterway restoration as a means to this end are the very people who experience difficulties with social interaction. This may have a detrimental effect upon the members of the group who might find it difficult to tolerate them. The leader will need to assess the situation. The solution could be as simple as moving the individual to another working group or team. However the leader must bear in mind that the happiness of the majority must outweigh the happiness of the individual although every effort should be made to ensure all volunteers can go home wanting to return.

40. As each group of volunteers is made up of individuals every group will be different. Each group will have its own language. The leader must identify with this language and use it when speaking to volunteers ~ after all there is little or no point in directing the volunteers by using a language they cannot understand.

41. The identity of the group as a whole will vary and a leader should be flexible, working within the groups identity rather than trying to change it into one that he might find easier to deal with.

42. A leader may use psychology to another advantage with the group. Some jobs within canal restoration are mundane and therefore not particularly appealing. For example, there could be thousands of bricks to clean off. After the average volunteer has cleaned a few dozen bricks boredom can soon creep in and it may be difficult to maintain the groups motivation. A good leader would hand tailor the team in such a way as to overcome this. Alternatively he may decide to allocate the more mundane aspects of the work as a means of exercising his authority over the group. He may choose to share out the work among everyone to show that there is no favouritism and to promote team spirit, but this may mean the loss of the dumper driver for half a day. Another method might be to draft one or two very talkative members into the brick cleaning crew who would boost morale in the team and help time to pass. Alternatively brick cleaning could be made into a competition with a prize for the greatest number of bricks cleaned off in a given space of time. The options open to the leader are almost endless. The task must be completed and the volunteers are there to do it. It is up to the leader to make the right decisions for the particular task and particular group, in order to encourage them along the way.

43. The majority of the work we undertake is performed by volunteers and the resulting labour force is drawn from a wide source.

44. A leader is well advised to assume that his work force does not have the requisite knowledge. By clearly outlining goals and instructing all volunteers wherever possible, he will establish a team and ensure that the group operates as effectively as possible.

45. This idea is best illustrated by imagining we are on the first day, on the work site. The leader asks if everyone knows how to use a shovel: Some of the volunteers will indicate that it is obvious how to use a shovel. The others will remain silent. Each of the silent ones believes that he is the only one there with this particular lack of knowledge, and would feel foolish to draw attention to the fact. Alternatively another leader might ask if there is anyone who does not know how to use a shovel. The result would be the same - silence from those in ignorance. A better approach, however, would be to show the whole group the correct method. By involving everyone, the leader has established a common method and although those who already knew would probably find the demonstration a little strange, the rest would have learnt without being singled out and made to feel foolish.

46. It is an important duty of the leader to ensure that the volunteers enjoy themselves as well as work successfully. We need volunteers to return time and time again. We need therefore to look at motivation more closely and see how positive leadership can prompt a good return rate.

47. Therefore, at the outset there are a number of volunteers who will form the group. It is the leaders responsibility to motivate and help the group develop, work well together and to promote both individual contributions and team spirit. The group or smaller sub-groups should be observed by the leader to allow him to identify any members are being excluded . If this occurs, the manner of exclusion also needs to be examined. Under certain circumstances the exclusion can be wholly justified, at other times it might be unreasonable. Each situation, therefore, needs to be evaluated on its own merits and appropriate actions taken by the leader. Some volunteers may prefer to exclude themselves. If they are happy to do this and there is no detrimental effect upon the group, intervention by the leader is not necessary, as efforts to include this person could result in new complications .

48. The leader has a duty to ensure as far as is possible that the volunteers enjoy their time. There may be volunteers whose attitude to the work spoils the enjoyment of the others. It has often been observed that during voluntary working parties some quick witted members have the potential to upset others with their remarks. The leader must be aware of this and be prepared to diffuse the situation as necessary. This requires skill and diplomacy and if handled badly could cause disaffection within the group and the undermining of the leaders own position.

49. Not all volunteers will express their opinions. This may be most apparent if there are members of the group who use loudly expressed views to dissuade others within the group from contributing. A study of facial expressions, other non-verbal communications or tone of voice may help the leader understand more about volunteer feelings when they ask if volunteers are all right and happy.

Motivation

50. Motivation is that which will induce someone to act.

51. If our volunteers were employees then we could perhaps entice them with more money to help them be motivated. Volunteers are however unpaid for the most part, so the leader needs to identify other methods. It could be interpreted that the very nature of voluntary work means no motivation by the leader is required because the volunteers have already motivated themselves to volunteer. This assumption is wrong and

volunteers, like employees, need to feel motivated and encouraged. The leader would be well advised to try to empathise with the group and identify the group's needs.

52. An ideal way of achieving this is for the leader to visualise the work for the week or weekend as a whole and divide this up into sections. Targets can then be set for each period for the group to reach. A leader may decide, for example, that by the end of the working day six courses of brickwork need to be laid. If the group know this target they can work towards it and when this particular task is successfully completed they can have time off away from the work site. This leisure time could be filled with a trip or other social event. By doing this and setting realistic targets both the work goals and volunteer motivation are achieved. This is an improvement on the outdated method of setting a rigid working day which provides the volunteers with little to work towards.

53. Leaders should give praise where it is due. If a volunteer or group have achieved a high standard or made an extra special effort this should be noted and rewarded. Happy volunteers will work better and achieve more, especially if they believe what they are doing is appreciated. Similarly, it is also important that if a group works badly, completes tasks to a lower standard, or goes against the leaders instructions the leader needs to act. There is no point in thanking volunteers for building the wall in the wrong place when instructions were plainly given. This would undermine any positive feedback and there needs to be a balance.

54. Another method of motivating a team is for the leader to take time out at the end of each working day to give positive feedback and highlight strengths. If the group can understand why they are doing a particular task and see how that task fits into the restoration project as a whole they are more likely to be motivated into working effectively and feel a sense of achievement in their efforts.

55. Many sites have visitors, from local dignitaries to sponsors. A poor leader will take the credit for the works, whereas a good leader will highlight the groups efforts, giving credit to individual volunteers and teams involved in the work. The credit, after all, should go to them. A leader who responds in this way is held in higher esteem and gains the respect of the group, who are more likely to work harder as a result.

56. Unfortunately, volunteers come and go and leaders need to accept that although certain volunteers are highly valued, no-one is irreplaceable or more important than the overall project of waterway restoration.

Leading a Team

57. A leader is one who leads others, therefore, a leader is not one who does everything himself. Leaders should delegate responsibility to others. There is little point in delegating a task to someone and then spending time going over the whole thing checking on what's been done. If the leader finds himself having to check up on a delegated assistant leader then that may be the leaders fault. The person the task was delegated to was, in that set of circumstances possibly the wrong choice. If a task is delegated out, the leader should be prepared to leave that person alone to get on with it, but remain available to give support and advice if asked.

58. The role of the leader is many fold. Even though good leaders are born, given thought and experience good leaders can become excellent leaders.

59. Organisations expect much from their leaders. It is often noted that the leader will become the public face of a group, no matter how much he refers people to the group. As such he will have to behave in a manner

befitting someone holding this high position. The volunteers need to have confidence in their leader. It would be detrimental if the leader were unable to cope with the strain of his demanding role. To help avoid this good planning is a must. A leader who is too full of his own importance will find it difficult to relate to the group. However, leaders need to be very slightly removed from the working group. If a leader were to be too close to the group it could result in all manners of problems brought about by lack of respect. How would it look if the leader was the one on the floor in a drunken stupor having his eyebrows shaved? If the leader never mixed with the group the results would be equally as bad. It is acceptable to "muck in" when you are a leader. It is a case of common sense prevailing.

The Importance of Planning

60. Before any work starts the leader should be aware of the tasks ahead and how to complete them in the time allocated. A good idea is to break the whole job down into more workable elements. These elements can be looked at and problems identified and solutions sought, before you can commence the project. Perfect planning prevents poor performance.

Power Pyramid

61. If leadership and its relationship to the volunteers and the governing body were to be imagined as a pyramid, then the leader would be above the volunteers but below the governing body. Sandwiched in-between like this he is under pressure to please everybody where ever possible. Volunteers need to be looked after, yet it is the leaders job to take action if volunteers act inappropriately. He must be prepared to support his group through thick and thin to others, who may include the governing body.

62. At the start of a working week or weekend where new volunteers are involved the leader should welcome them personally. This however in the real world of waterway restoration is not always possible. There are last minute arrangements to be made, materials being delivered and other important duties to attend to. Eventually the leader and the volunteers will meet. Proper introductions are important as it is essential for the leader to learn the names of the volunteers. The leader should clearly outline his expectations of the volunteers. By doing this at the start the leader can identify the individual characters that will form his group.

63. Leaders are the people in charge on the ground. By the very nature of the work they are there with the group and are ultimately responsible for their well-being. Leaders should be aware at all times of factors that might affect the volunteers, for example, working in extremes of heat or cold ~ appropriate actions should be taken promptly.

64. More mature volunteers might, and often do, try to work harder and at the pace of younger members of the group. In these circumstances it can be difficult for the leader to tell an older volunteer to slow down or take a break. One method that might be employed is to be prepared to move the more mature volunteer to a less tiring task if necessary. A diplomatic pretext for this could be that you want them to sort out another problem elsewhere.

65. At the end of a working project it is often a good idea for leaders to treat the volunteers as a way of thanking them for their hard work. An example might be a last night meal cooked by the leaders, or the leaders abstaining from alcohol and driving to give the group an opportunity to let their hair down.

66. It must be remembered that leaders are volunteers too. This fact is easily overlooked and is sometimes forgotten by groups and by persons further up the power pyramid. A burnt out leader is of no use to the group and of no use to himself. It is all too easy to be so wrapped up in the needs of the volunteers and the task at hand that the leader may forget his own well-being. A leader should be able to identify the volunteers he can trust the most. If it is pointed out that they feel that the leader is working too hard, or suggest that the leader should maybe take an afternoon off then this advice should be listened to very carefully. There is no task connected with waterway restoration that is so important that it is worth the leader making himself ill over.

67. The flight of wild geese gives us an unusual example to illustrate the need for leadership and teamwork.

68. Geese fly in a "V" formation to reduce the amount of effort each goose needs to become airborne and fly in the right direction ~ as a result they have a 71% better flying range than if they flew alone.

69. * We achieve more as a team than working alone *

70. When the lead goose becomes tired, it rotates back into the formation and another goose flies to the front.

71. * Leaders need to be prepared to let others help! *

72. Geese in formation communicate with each other. Geese will encourage their leader to lead on. This spurs on those at the front with the knowledge that they have the support of their flock to do well.

73. * Leaders must also remember to encourage all in their group in the same way by giving praise. *

74. In an ideal world all the volunteers would be happy ones. The work would be completed to the required high standard without any major hiccups along the way. All the leaders would go away with the feeling of satisfaction borne out of this. However this is not an ideal world. The leader must accept that there will be problems along the way. There will be occasions where he is asked to deal with situations arising from a clash of character that he would rather be in ignorance of.

75. All that can be expected of any leader is that they genuinely try their best, that they make their decisions with thought, care and above all try to enjoy themselves.

Forty helpful hints that might help in the smooth running of a Canal Camp or similar type work camp

1. Draw up a rota to ensure even and fair distribution of chores among volunteers.

2. Delegate someone to charge the radio and telephone batteries.

3. Always refill the site water boiler after tea breaks.

4. Learn volunteer names and refer to them by the name they wish to be called.

5. Ensure first aid kit travels to site with first group of volunteers.

6. Insist that all volunteers remove boots in the accommodation if the site is muddy.

7. State a lights out and quiet time each day and ensure it is adhered to.

8. Write the name of the days duty driver on an information board each day.

9. Delegate someone to be responsible for taking adequate supplies of drinking water to site.

10. Keep written information of tasks undertaken by D of E volunteers, as this will help when writing up the books.

11. Ensure there are adequate evening snacks (e.g. biscuits and bread) to avoid the food stocks being devoured prematurely.

12. If adopting a no smoking policy in the accommodation ensure there is a suitable butt container placed outside.

13. Take time out to talk socially to the volunteers.

14. Monitor volunteers constantly to avoid fatigue whilst working.

15. Consider how your appearance as leader may be interpreted by others.

16. Remember the importance of the cook and stress this to the volunteers.

17. If there is no full time cook rota as many of the volunteers as possible. This will give everyone the opportunity to experience the difficulties.

18. Involve the local society or group.

19. Show the volunteers works already completed wherever possible.

20. Allocate part of the budget for special treats for the volunteers, for example “Ice pops”.

21. Music in the accommodation can be a good ice breaker.

22. Try to boost the confidence of insecure volunteers. For example by giving them a special task to do.

23. Inform volunteers that if they have a problem that they feel unable to approach you with then “Old hands” are available, and point them out.

24. Hydraulic machinery does not require physical strength to operate.

25. Ask the volunteers to suggest what type of food they would like to eat.

26. Try to convey even bad news in a positive way.

27. With Canal Camps by Waterway Recovery Group, remember that leaders have the backing of the Waterway Recovery Group board of directors.

28. If leading for anyone other than Waterway Recovery Group confirm where your backing will come from.

29. Sometimes contractors or paid employees will need your leadership. Be prepared to deal with these in a positive way.

30. Make yourself aware of the correct procedure in disciplining D of E volunteers.

31. D of E books can only have positive comments. Remember that if the candidate was unsatisfactory then the book must not be signed.

32. Be prepared to send disruptive volunteers off the work site.

33. Give the volunteers clear explanations of what is expected of them and how their work fits into the restoration project.

34. Every minute spent explaining to and motivating volunteers will pay off ten fold later.

35. Explain to volunteers that as leader you appreciate that they are there to have fun as well as to work.

36. Explain the hierarchy, for example leader, assistant leader.

37. Inform the volunteers that as leader you are a volunteer too.

38. Set aside time to compile the D of E books.

39. Make sure volunteers appreciate the seriousness of the safety talk.

40. Reassure parents that their child will be looked after during their stay at a camp.

Practical Restoration Handbook

Plant

by

John Palmer
(WRG Plant Manager)

CONTENTS

Note: The use of **Pumps** is described in the chapter on **Dewatering**.
The use of **Excavators** is described in the chapter on **Excavation**.
The uses of **Chain-Saws, Brush-Cutters & Hand-Operated Winches** are described in the chapter on **Vegetation Clearance**.
Health and Safety is the subject of a separate chapter so only points specific to the plant under consideration are covered in detail here.

1. INTRODUCTION

1.1 In the beginning were the pick, the shovel and the wheelbarrow. With little more than these three basic items of equipment was much of Britain's canal network constructed by the original *Navvies*.

1.2 With little more than these same three basic items did what have been called the *New Navvies*, the volunteers who have already helped restore over 300 formerly derelict miles of that network, begin their work. It soon became clear, however, that hand tools were no longer adequate when the numbers of Navvies could be counted in tens rather than the thousands of their forebears and their labours were additional to, rather than forming the substance of, their full-time employment. The use of the more sophisticated tools and mechanised plant made available by technological progress in the intervening two hundred years became an absolute necessity if the rate of restoration was ever to outstrip that of the continuing slide into dereliction.

1.3 Most common items of plant are described in the chapters of the Practical Restoration Handbook which covers the applications with which they are particularly associated. This one aims to fill some of the gaps.

1.4 Where appropriate, peripheral operational considerations are also discussed.

2. HEALTH & SAFETY

2.1 If you look at photographs of volunteers working on canals during the 1960's & 70's you will see little evidence of safety consciousness. Sites were rarely fenced, hard hats rarely worn, *Totectors*™ virtually unknown, etc. Despite this, accidents were extremely rare and the few that did occur were minor. However, the increased general awareness of safety issues and the additional risks that arise from the greater use of mechanised plant now renders unacceptable such a relaxed approach. Safety is now not just a priority, it *is* the priority.

2.2 Three groups of people must be considered:

- the plant operator(s) on the active site
- other site workers on the active site
- the general public on the active site AND THE INACTIVE SITE

2.3 Active sites present more obvious risks but water and fall hazards may be present even when the workers aren't. "Fallow" periods are, of course, longer on volunteer sites than on professional ones so, if anything, even greater care is needed.

2.4 **The public** are best protected by appropriate fencing. This can range from orange tape round a few lamp irons (for temporary, shallow excavations) to a full post and rail fence (at the top of a long-term empty lock). However, when plant is in use close to a footpath, fencing alone may be insufficient and it may be wise to erect warning signs and even detail someone to escort people past the site. Do not be surprised, however, if some refuse to wait for safe passage. The 1994 Waterway Recovery Group (WRG) Reunion Dig at Derby was notable for the number of (particularly) cyclists who ignored the legal path diversion order and forced their way past both barriers and stewards to ride over winch cables and under trees being felled.

2.5 **Site workers** are, to a large extent, responsible for their own safety. They should keep clear of working plant, never, for example, taking short-cuts over taut winch cables or through the working arcs of excavators, and should not take breaks in the shelter of plant, tempting though getting out of the sun/wind/rain can be. If they fall asleep and the driver forgets to make his pre-starting inspection they could quickly become ex-workers.

2.6 Most plant is designed to take the operator only; lifts should neither be sought nor given.

2.7 **The plant operator** has, of course, most responsibility. Specific points are mentioned under the item(s) of plant in question but the following apply to all mechanised plant.

2.8 On all sites that participate in the IWA/WRG insurance policy, unless under tuition by an authorised Instructor, you must be authorised to use the plant in question and have your Driver Authorisation Card with you. See PRH "Health and Safety Section 2" for further details.

2.9 You must be stone cold sober before operating any plant. As alcohol takes some time to clear the system, this may preclude operating plant "the morning after the night before".

2.10 If one is available, read the instruction manual thoroughly before first acquainting yourself with the machine. Even if not, make sure you know how all the controls work and, in particular, that you know how to stop the thing before starting it. It's too late when it's running away from you and much too late when you're running away from it.

2.11 Hire plant is usually well labelled but make sure that all filling and operating points on owned plant are fully labelled.

2.12 Make sure that all guards are in place and don't try to by-pass interlocks. If any warning labels are faded or worn then replace them as they can save both money (no more diesel in the hydraulic tank) and lives (everyone knows where the emergency stop is).

2.13 If a machine's throttle sticks, stop the engine before trying to free it.

2.14 It is dangerous to operate the controls of any sit in/on machine other than when sitting in the seat. The possible consequences of accidentally knocking a machine into gear or activating a "slew" control while outside the cab are very serious indeed.

2.15 Never operate machinery when alone on site. A radio is a useful safety device if not alone but sometimes out of site, e.g. carrying materials down a towpath in a dumper.

2.16 Unless you are blessed with eyes in very strange places you will, at some time, require the services of a banksman (someone who gesticulates to you to indicate what you should do). If possible, use an experienced machine operator and only take instructions from one person at a time – though it is prudent to stop if anyone shouts to you to do so. Don't be embarrassed to get someone to guide you over bridges or round obstacles. You'll be much more embarrassed when you're stuck with two wheels in a ditch.

2.17 Except in exceptional cases all WRG sites are Hard Hat Sites but other clothing is left to the discretion of leaders and volunteers. Steel toecap boots, strong gloves and overalls are highly recommended. It is a good idea to have separate gloves for site work and operating plant; mud on the controls is neither pretty

nor conducive to safety. Be careful with your choice of ordinary clothing. Despite careful guarding, dangling bits such as belts, scarves, ties, anorak draw-cords or even uncontrolled long hair can all too easily get caught in rotating machinery, drawing in parts of the volunteers body with serious and painful consequences. See PRH "Health & Safety Section 1" for further details on personal protection equipment.

2.18 Most items of plant have limited sound insulation and some, particularly the older ones, have rather primitive exhaust silencing. The use of ear defenders, certainly by operators and possibly by others in the vicinity, is recommended. In dusty conditions you may also like to consider goggles (and possibly a dust mask) as well.

3. BUY OR HIRE?

3.1 – the perennial problem. The answer depends on a fine balance of cost and convenience and varies from group to group, site to site, job to job, and even day to day. This table will, perhaps, point you towards the things you need to think about.

	Owning	Hiring
Cost	Usually cheaper for inexpensive items used frequently – but beware of hidden expenses (e.g. insurance)	Usually cheaper for expensive items used infrequently – no hidden expenses (unless you b*****r it up)
Use	Familiar – more efficient use and less/easier operative training	Unfamiliar but more modern – meet all current regulations
Access	Easy if stored (see below) close to site – can be a problem if not	Collection and return limited to the working week
Storage	Need a secure storage facility – problems with vandalism and theft	Sensible, on-site, precautions only
Maintenance	Requires time and skills but the latter then available when needed	Usually well maintained but usually no breakdown cover at weekends
Specials	Can adapt items if required	Standard items only
Publicity	Can use as a mobile advert	Hire company publicity only

3.2 Typically, canal societies find it economical to own pumps, dumpers, wheeled excavators, generators, mixers and compressors when they can obtain them cheaply and have regular (i.e. at least monthly) use for them. All these are relatively easy to move to-and-from and between sites. A few have larger, less mobile, plant in long-term use on particular sites.

3.3 WRG maintains a stock of plant (see Appendix 2) which is available on free loan to canal societies. The societies pay transport costs and are responsible for maintenance of the plant while it is in their charge.

4. POWER SOURCES

4.1 Diesel Engines

4.1.1 The modern diesel engine (and even the museum pieces in WRG's older dumpers fall into this general category) is an amazingly reliable beast. As diesel fuel is also less flammable and much cheaper than petrol ("site only" plant runs on "red" diesel which carries no excise duty), most

plant is now diesel powered, either directly or, for example, by electricity from a diesel generator, though some barrow-hoists, concrete-mixers, generators and pumps are petrol-powered (for lightness). Smaller machines typically have hand-start, single-cylinder, air-cooled engines, though two- and three-cylinder engines are not unusual. Modern equipment tends to be larger, with water-cooled, three- or four-cylinder, electric-start engines.

4.1.2 Unlike petrol engines, in which the fuel/air mixture is ignited by an electrical spark, diesels rely on the heat generated by the compression of the air in their cylinders spontaneously to ignite the fuel. To generate sufficient heat the compression ratio has to be much higher than in a petrol engine, typically 20:1 c.f. 8:1, making it virtually impossible to turn even a small diesel engine by hand. Consequently, hand-start diesels have small levers (one per cylinder) mounted on the cylinder head cover(s) which, when turned through 90-150° (varying from engine to engine), open the exhaust valve(s) slightly, allowing some pressure to escape. These, unsurprisingly, are known as "decompressors".

4.1.3 Tough as the proverbial old boots diesels may be; nevertheless, they are not totally immune to neglect and abuse. **Regular maintenance** is the key to long and reliable operation. Consequently, check as many of the following as are applicable to the engine of your machine before starting it each morning:

- Lubricating oil level
- Cooling water level
- Belt conditions and tensions
- Fuel level (see 4.3)
- Check also for leaks, loose nuts and bolts, etc.
- Checks appropriate to specific machines are covered in the appropriate sections.

4.1.4 Rectify any problems before using the machine. This may be easier said than done but is preferable to the trouble that will ensure if you don't.

4.1.5 **Starting** is best carried out according to the instruction manual, if available. If it isn't the following may provide useful general guidance:

4.1.6 If relevant, ensure that the machine is in neutral gear and that the hand-brake is on.

4.1.7 If hand-starting, make sure you know which way the engine runs (counter/clockwise) and that you have the right starting handle. Some are reversible. If so, make sure the ratchet is correctly set. There are few surer ways of kn*****ing yourself than trying to start a diesel engine in the wrong direction. Before starting, lightly grease the shaft and turn the handle the 'wrong' way to ensure that the ratchet is working.

4.1.8 Operate any excess fuel device. These take many forms but are typically a lever or slider linked by a spring assembly to the fuel pump, careful examination of which will usually be sufficient to identify it and determine how it works. The device is usually held in its actuated position by a shallow notch, or similar, and returns automatically to its running position once the engine starts.

4.1.9 Activate the decompressor(s). Hold the starting handle correctly (i.e. thumb on the same side of the handle as the fingers), turn slowly a few times to get lubricating oil circulating, then wind more vigorously, building up momentum before "dropping in" (releasing) the decompressor(s) without stopping winding. On multi-cylinder engines it is often best to drop the decompressors in one at a time and, though usually linked when new, the linking bar will usually be found to have been split to make this possible.

4.1.10 If the engine has not started within a reasonable time, investigate the problem.

4.1.11 If the starting handle stays on, spinning quickly, get smartly out of the way and stop the engine by any means possible without getting in he handle's potential flight path. Under no circumstances try to grab it.

4.1.12 **Diesel engines are stopped** by cutting off the fuel supply, not, as is widely believed, by use of the decompressor(s), an exercise likely to result in bent valve stems and an irate plant manager. Cutting off the fuel usually involves pushing the throttle further back than its normal tick-over position and holding it until the engine has completely stopped. As with the excess fuel device, the exact operation of the fuel cut-off is usually obvious from an inspection of the fuel pump if instructions are not available.

4.2 Petrol Engines

4.2.1 These are much less robust than diesels and require more care. Most of the engines you are likely to encounter will be single-cylinder, two-stroke units which run on petrol/oil mixtures. Problems likely to be experienced are failure of the HT (high tension) electrics (the power to the spark plug), oiling or sooting of the plug and flooding with, or starvation of, fuel as a result of carburettor faults. Some engines, particularly the US-made *Briggs & Stratton* ones, have very simple carburettors which can become temperamental as they age.

4.2.2 **Some basic safety points:** Petrol is both much more flammable and much more volatile than diesel oil. Its vapour is also heavier than air and can spread considerable distances before being diluted to safe concentrations. Consequently, never smoke near petrol-engined plant and never refuel a petrol-engined machine while the engine is hot.

4.2.3 **Routine maintenance** is basically the same as for diesels but check also the electrics. A water-repelling spray (such as WD-40™) is an essential maintenance item.

4.2.4 **Starting** is, again, best accomplished by following the instruction manual, if available. If not, try the following:

Almost all petrol engines found on small plant are rope start. Some have "captive" starting strings but most are the "lace it up yourself" type. A length of rope 5-8mm in diameter with a large knot at one end is placed through the slot of a slotted capstan attached to the end of the crankshaft, with the knot inside the capstan. The rope is then wound tightly in the right direction (obvious from the shape of the slot) around the capstan and, once fully wound, pulled sharply, spinning the engine. Do not wrap the starter cord round your hand/wrist; if a unit back-fires you may not be amused. Now put the string somewhere safe!

4.2.5 The most common reasons for the failure of petrol engines to start are:

- Fuel tank empty
- Fuel not turned on (rotary or push-pull tap, usually under the fuel tank)
- Choke not activated (if cold) or activated unnecessarily (if hot)
- Spark-plug still shorted out by the stop switch (see below if this isn't clear)

– so check these before you even try pulling the string!

4.2.6 If you still don't have any success check for:

- Wet electrics (remove, wipe dry and/or apply the aforementioned WD40™)
- Water or dirt in the fuel
- Dirty/wet spark plug (remove and clean/dry)

4.2.7 If all else fails, go and hire a diesel-engined equivalent.

4.2.8 There are two basic ways of **stopping a petrol engine**. The first – more appropriate for short stops than long – is to short the spark plug to earth. Many small units come fitted with a "switch" – often no more than a strip of spring steel attached to the cylinder head – for just such a purpose. Although effective, this leaves the carburettor full and the fuel line open to the tank. Consequently, in the event of a leak, there is a significant risk of fire.

4.2.9 The second – recommended for overnight stops – is to turn off the fuel supply at the main tap, allowing the engine to stop by running out of fuel. This takes a few minutes but leaves the fuel line closed and carburettor substantially empty and minimises any fire risks. It also prevents the evaporation of the more volatile components from the mixture in the carburettor, making starting easier next time round.

4.3 Refuelling (Petrol and Diesel)

4.3.1 Refuel each evening, if possible. This gives any debris stirred up by the operation time to settle before it can be carried into the carburettor/injector pump, helps prevent condensation forming overnight in the tank and reduces the chances of losing working time waiting for the engine to cool when you run out half way through a session. If your machine won't run for a full day on one tankful, top it up after breaks; this at least saves the cooling time.

4.3.2 Refuelling should be carried out away from the working area. Containers should be clearly marked with their contents. Diesel oil in petrol engines simply doesn't work and has to be cleaned out, wasting time but presenting few risks. Petrol in diesel engines is dangerous, at worst leading to explosive self-destruction of the engine. It should also be noted that the requirements of petrol engines can be complex. Four-stroke engines may require leaded or unleaded fuel and two-stroke mixtures vary from about 6:1 (petrol:oil) to 25:1. Make sure you know what fuel your machine requires and use it.

4.3.3 When refuelling from a drum, make sure that none of the rubbish that inevitably collects in the bottom gets into the tank, firstly by using a funnel with a fine gauze filter (also helps prevent spillage) and secondly by not emptying the drum completely. Use the dregs for fire-lighting; if you have no fires to light, put all the similar dregs (don't mix fuels) into one drum, carefully decanting off the good stuff after allowing it to settle.

4.3.4 When fuelling machines, only use old drinks containers as a last resort. Red diesel looks remarkably like blackcurrant drink but tastes quite different. If you have to use a drink container, empty it and then burn or otherwise destroy safely.

4.4 Electrical Power (including Generators)

4.4.1 It is rare for mains power to be available on site; if so, it will probably be 415V, 3-phase. Leave this to a qualified electrician.

4.4.2 Electrical power is usually obtained from a **mobile generator**. Small ones (up to about 2 kVA) are usually petrol-engined and contained within a tubular frame for two-man carrying. Larger ones are usually diesel-powered and wheeled. Most provide both 240V and 110V though, for safety, all plant used on site should operate on 110V, if possible wired 50/0/55V.

4.4.3 To minimise problems, **cables** usually have industrial terminations (all right, plugs and sockets) which are colour-coded. Yellow = 110V; blue = 240V. They are known as either "C form" or BS4343). Different voltage connectors are deliberately designed not to fit each other so don't try to make them do so! When setting up, make sure your cable is adequately sized for the electrical current you expect to use. Remember that what will take a lot will take a little and that inadequate cables have caused many an elusive problem.

4.4.4 The most common electrically-powered items of plant are demolition hammers (aka breakers) and small mixers, though there are also a few electrically-operated pumps and barrow-hoists around. **Starting and stopping** them is usually just a matter of turning a rotary switch.

5. PLANT FOR LIFTING, LOADING & MOVING

5.1 Skid-Steer Loaders

5.1.1 General Description and Preparation for Use

5.1.1.1 Skid-steers are loading shovels, not excavators; most can also be fitted with pallet-forks to provide a basic fork-lift facility. They are designed to operate in flat builders' yards, not on rough sites, having poor ground clearance and less than brilliant stability on rough terrain. Moreover, they don't dig holes very well and landscaping must be done backwards as their tyres make a mess. If that leaves you wondering why they are worth having at all, they are highly manoeuvrable, versatile machines and can be worth their (not inconsiderable) weight in gold on a suitable site. Being narrow, they are particularly valuable for towpath work.

5.1.1.2 The Operators Manual should be available. Read it.

5.1.1.3 The main pre-operational checks on skid-steers, in addition to the engine checks already mentioned are:

- Hydraulic fluid level (don't let hydraulic pumps run dry. The oil acts as both lubricant and coolant so a dry pump quickly self-destructs. *Case* machines use engine oil plus a special additive)

- Check also that the hydraulic hoses are properly connected or (if using forks) the couplings protected with proper bungs
- Brake and clutch fluid levels (if they have a brake or clutch)
- Ensure that, when released, all control levers return to their natural positions
- Tyres (check for general wear and especially for bricks, etc, stuck between the tyres and chassis as they will quickly shred the tyres)
- The Roll Over Protection System
- The counterweights (on the back of the machine. Make sure they're there)
- Bucket pins and teeth (if fitted)
- Grease all nipples every 10 working hours or before leaving the machine unused for an extended period (beware of the exhaust if it is hot)

5.1.1.4 Switching between bucket and pallet-fork operation involves the removal and replacement of pivot pins and hydraulic hoses and is a heavy, two-man task. Care with your thumbs!

5.1.2 Controls

Familiarise yourself with these before using them for real. All skid-steers, being diesel-hydraulic, have hand throttles and are then controlled by variable-displacement hydraulic valves. Most (probably all) have a pair of hand-operated levels, either side of the driver, forward/back movements of which produce corresponding movements of the equivalent wheels. Side-to-side movements usually control other functions (typically raising/lowering of the arms and in/out rotation of the bucket) but these vary somewhat from machine to machine. Opening of the four-in-one type of bucket is usually effected by a foot pedal.

5.1.3 Operating Techniques

5.1.3.1 Always leave the machine with the bucket on the ground when unattended and never step out of the cab with the bucket up or allow anyone to walk under the raised bucket, even with the engine off. Gravity never switches off so it can still fall and crush you/them if a lever is accidentally caught or a hose damaged.

5.1.3.2 For the same reason, always prop the arms if it is necessary to work on a raised bucket.

5.1.3.3 Do not enter or leave the machine while the engine is running. It is all too easy to catch a control with an arm or item of clothing – with unpredictable, but probably unpleasant results.

5.1.3.4 Always use the safety belt. As well as contributing to your safety in the event of an accident, it gives you better control because you don't bounce around the cab as much.

5.1.3.5 Set the engine speed appropriate – just fast enough for what you want to do.

5.1.3.6 Make gentle moves. Skid-steers will turn in their own length but doing so should be avoided unless absolutely necessary. It makes a mess of both the ground and the tyres.

5.1.3.7 As already mentioned, skid-steers are not naturally the most stable items of plant. Good driving is, therefore, largely about maximising machine stability. Thus:

- Always keep your load as low as possible
- Beware hills and side slopes. Even more importantly than with other items of plant, tackle hills square-on, perhaps going backwards UP hills if unladen
- Consider the effect that tipping your load is likely to have on the stability of your vehicle before actually doing it
- Be aware that the angle of the bucket changes with elevation, as does visibility

5.1.3.8 Other sensible points, in no particular order, include:

- In the event of losing control, simply release all levers and stay in the vehicle. The ROPS will protect you
- Hydraulic valves sometimes do not close completely so beware of creepage of the travel motors. Apply the brake, though, as this often works on one side only, your machine may simply execute a slow pirouette instead of a straight crawl
- Don't leave the machine on a slope without proper chocks
- When shovelling, keep the base of the pile neat and flat
- Sheet loads if windy and dusty
- Beware when tipping into trenches as your front wheels are very close to the bucket. Use a stop board to avoid falling in
- Be careful if using a loader to lift items using chains or strops, in particular beware of cutting strops, etc on sharp edges on the bucket
- Always wear ear defenders; add goggles when working in dusty conditions

5.2 Dumpers

5.2.1 General Description and Preparation for Use

5.2.1.1 Anyone reading this Handbook is likely to be familiar with the general concept of dumpers. What they might be unaware of is that they come in three basic forms:

- Rigid chassis with rear-wheel steering (2- or 4-wheel drive)
- Articulated chassis (usually 4-wheel drive), and
- Rigid chassis with rear tipping

5.2.1.2 The first of these is the traditional, builders' dumper, usually with a single cylinder, air-cooled, diesel engine (see 3.1), mechanical drive, a 15cwt (750Kg) payload and manual tipping. WRG owns a number of these and individual canal societies have others; they are also widely available from hire companies, as are larger machines with multi-cylinder engines and hydraulic tipping.

5.2.1.3 The second is the modern, contractors' dumper, usually available in 2, 3 and 5 tonne versions from hire firms. They have three- or four-cylinder, water-cooled engines and electric start. Tipping is invariably hydraulic.

5.2.1.4 Rear-tipping dumpers are the huge long things seen on major road-building sites but a fairly recent addition to the canal restoration scene, albeit a predictable one as the scale of earth-moving on canal restorations increases. These resemble nothing so much as very large tipper lorries and that, in effect, is what they are – with all-wheel drive. They start at about 10 tonnes payload and go up!

5.2.1.5 These three types of machines have quite different handling characteristics. Be careful the first time you use each type and familiarise yourself with its handling on a large, open area before heading off down a narrow towpath.

5.2.1.6 There are also a few 'specials' such as swivel-skip machines (rigid chassis machines with small, high-set skips which rotate and will tip up to 90° either side of straight ahead).

5.2.1.7 The main pre-operational checks on dumpers, in addition to the engine checks already mentioned, are:

- Hydraulic fluid level (don't let hydraulic pumps run dry. The oil acts as both lubricant and coolant so a dry pump quickly self-destructs)
- Brake and clutch fluid levels
- Ensure that, when released, all control levers return to their neutral positions
- If applicable, go round all the grease nipples with a grease gun

5.2.2 Loading

5.2.2.1 During loading the machine should be properly braked and, if on a slope, chocked. The engine should be stopped and the driver off the machine. (Time for a brew!). If this seems pedantic, remember that a stray stone/brick/clod of earth can be enough to knock a machine into gear with potentially interesting results.

5.2.2.2 Positioning for loading is a juggling act between the respective machine drivers. Normally this presents few problems after a bit of practice but remember that you are responsible for the machine you are driving.

5.2.2.3 If the loading shovel is wider than the dumper's skip, try putting two dumpers side by side or nose to nose to reduce the amount spilt.

5.2.2.4 Do not overload the dumper with materials – very easily done with mechanised loading. Any time saved in a reduced number of journeys may well be lost by having to remove part of each load with shovels before the bucket will tip.

5.2.2.5 Don't overload the dumper with strange shaped loads – if the load won't sit in the skip ensure it is safely fixed, but if tying it down make sure it does not foul the steering system, brake rods, hydraulic pipes or the tip lever.

5.2.2.6 Be aware of debris build-up around the (foot) controls and keep the driving area as free as possible. A stone jamming under the brake pedal could provide some unwanted entertainment.

5.2.3 Controls

5.2.3.1 The gears are usually

```
1          3
|----- N -----|
R          2
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on older, rigid-chassis models – but 1st and 3rd are sometimes reversed

5.2.3.2 Newer, hire machines usually have four-speed gear boxes and separate forward-reverse controls. Some even have electro-hydraulic drivers that render the clutch redundant other than for emergency use. With these, however, beware of the vehicle's moving off immediately you select a gear in the main box because it is already in forward or reverse. You don't need to touch the clutch. The gear positions are usually well marked. Beware also that some new machines have interlocks fitted between the clutch and the starter – bizarrely some will only start if the clutch is depressed while some will only start if it is not.

5.2.4 Driving

5.2.4.1 When returning from a break it is a good idea to walk right round the machine to ensure that no-one has fallen asleep in its shade.

5.2.4.2 On 3-speed machines you will usually find 2nd gear adequate for most driving, whether laden or unladen. Use 1st for slow-speed manoeuvring and climbing/descending slopes, 3rd for driving unladen to and from the storage compound. On 4-speed machines read 2nd and 3rd for 2nd, and 4th for 3rd. Never use the clutch pedal as a foot rest.

5.2.4.3 Try not to drive with your fingers right round the steering wheel. If the machine finds a hole and the steering kicks your hands may suffer.

5.2.4.4 Let the engine do the major braking when descending slopes, etc. resist the temptation to put your foot on the clutch.

5.2.4.5 Think where the centre of gravity is and make sure that it is as far inside the wheel base as possible, bearing in mind that it will change depending on whether your dumper is loaded or not and whether you are going up or down hill. Tackle slopes square-on to minimise any sideways lean. Always use the engine for braking when descending hills. If you need to drive backwards to maximise stability, so be it.

5.2.4.6 Going through mud is best done in as straight a line as possible. This is very important with the smaller, 2-wheel drive machines where the rear, steering, wheels often tend to drag rather than steer. If you bog a machine down and can't drive it out then try winding it. Put it into gear and, with the decompressor(s) operated (very important – if you manage to turn it over without, the machine might start), wind it out slowly with the starting handle. This technique is not guaranteed but has quite a high success rate and is well worth a try.

5.2.4.7 If you meet ruts and your machine does not fit them, drive far enough to one side for one pair of wheels to run in a rut with the other pair on the top of the hump between them – or even further to one side so that one pair is beyond the rut and the other on the hump.

5.2.4.8 When preparing to go along relatively narrow embankments, stop and get off the machine to check your position (if in convoy with a similar machine, observe it) and be aware that vegetation can obscure what is there. Ditches and edges are easily missed. If you need to pass walkers on a narrow path the safest way is to stop your machine and let them pass you.

5.2.4.9 If you can't see properly over a load, drive backwards.

5.2.4.10 On a windy day if the load (or road) is dusty you may well require goggles.

5.2.4.11 Black smoke is usually a sign of excess fuel and is a common fault. The proper solution is to get the injector(s) serviced. Until this can be arranged, driving gentle, pressing the accelerator down slowly and progressively as your speed increases, will help.

5.2.4.12 Most dumpers are not licensed for use on public roads. These carry no license plate but the presence of a number plate does not necessarily mean that the dumper is road legal. Others are limited to short distances on the highway, e.g. crossing a road between parts of a site. Check the legal arrangements with the site leader.

5.2.5 Tipping

5.2.5.1 Tip in as straight and level a line as possible. When tipping near/over an edge, put down a couple of blocks (railway sleepers are ideal) as stop boards for the front wheels. If the ground is too soft to peg them securely, try attaching them to a couple of lengths of chain pinned to some secure ground behind you.

5.2.5.2 Remember that a dumper's centre of gravity moves significantly as the skip rises. This is important on rigid chassis machines, more so on articulated ones and extremely so on the swivel skip ones that are making an appearance on an increasing number of sites. That amount of load, that high up, can be interesting. And, as for tipping on a downward slope. . .

5.2.5.3 When driving in the tipping area, beware of sharp things like reinforcing bar sticking up. A puncture is a nuisance at the best of times; on an unstable tip it can be a major problem.

5.2.5.4 Keep an eye on crud build-up in the skip. It may need shovel work now and again.

5.2.5.5 Don't use the skip as a bulldozer.

5.2.6 Towing

5.2.6.1 Their ability to cope with heavy site conditions makes dumpers favoured vehicles for towing unpowered plant such as pumps and compressors. However, there can be problems.

5.2.6.2 Tow very carefully, especially when using the smaller dumpers which only have brakes on one end, usually the driving (front) wheels. Be particularly careful when towing mixers or other narrow-chassied machines because they are prone to fall over, especially on rutted tracks. Try having someone walking behind watching from a safe distance.

5.2.6.3 Think carefully before stopping the engine. Your tow may prevent access to the engine with the starting handle.

5.2.6.4 If you have to tow the machine out of a hole ensure that the tow rope does not catch any brake rods or any pipework, and that it is protected round any sharp edges.

5.2.7 Parking

5.2.7.1 When parking a hand-start machine, don't reverse it up to a wall, or similar. It might look tidy but makes inserting the starting handle more fun than you really want.

5.2.7.2 When parking an electric-start machine, think about the possible need to jump start it next time, much more likely on an intermittently-used machine than one used regularly. Remove the keys if there is any chance of unauthorised people getting access to the machine.

5.2.7.3 When parking a dumper fitted with hydraulics, leave the minimum of chrome showing on the rams; it reduces corrosion and extends the life of the ram.

5.2.7.4 Don't leave parked dumpers in gear; they could accidentally be bump started.

5.2.7.5 Do not go under a raised skip unless it is carefully blocked. The manual unit will normally try to roll back on its own. A hydraulic unit may well fall back if someone moves the lever (with or without the engine running) or you accidentally sever the pipe.

6. PLANT FOR LOCK CLEARANCE

6.1 Barrow Hoists

6.1.1 General Description

6.1.1.1 A barrow hoist is basically a small, portable (joking!) crane designed to mount either directly on scaffolding or on an (equally portable) independent stand. There are two basic variants.

6.1.1.2 In the older type, exemplified by those made by *Ace* and *Saga*, a cable, fixed at its inner end to a winding drum, passes over a pulley near the end of a 6-8' jib, through a pulley block carrying the lifting hook and is then fixed back to the jib. It is wound in/let out by means of an engine, usually petrol-powered, occasionally diesel or electric, which drives the drum *via* a clutch/brake assembly. The independent stands are usually large steel tripods or pyramids, supporting vertical "masts" on which the motor/drum/jib

assembly mounts. *Ace*'s jibs are detachable from the motor; *Saga*'s are permanently linked.

6.1.1.3 Modern hoists resemble miniature overhead cranes, having a gantry and an electric motor. Although much quieter than the old type, most require the operator to reach out into space both to use the operating level and to load/recover barrows. A few have pendant controls but still present difficulties with barrow handling. Concern has been expressed about the safety of this type of hoist but they are widely used by the building trade without obvious problems and are what you will get if you hire one.

6.1.1.4 Beware the potential build-up of exhaust fumes in a lock chamber.

6.1.2 Setting Up

6.1.2.1 At all times when working near the top of a lock, don't forget the drop – it's a long way down!

6.1.2.2 You don't have a lot of choice of site; it has to be one or other edge of the lock you want to clear, preferably the one where you are going to tip the sh*t that comes out. That said, a horizontal flat area, free of debris and undergrowth and with adequate working space (say a minimum of 8') around, is highly desirable and contributes greatly to safety and ease of operation. For reasons associated with water control in the lock it is usually best to site the hoist close to the bottom gate recess on your chosen side.

6.1.2.3 Ensure that there is a solid section of wall below you, without overhangs – and a good barrow run. Pushing the first barrow of the day on a firm, level surface is easy: pushing the four hundredth up a by now soft and slippery slope can be seriously hard work. Emptying barrows is the most physically demanding job in canal restoration so time spent preparing the barrow run is time well spent.

6.1.2.4 If you need to carry a hoist any significant distance two methods are available. The first is to put the motor unit in a barrow; this is straightforward with an *Ace*, less so with a *Saga*, a second person being needed to steady the jib. The second is to mount the motor unit temporarily on two lengths of scaffolding, making it a four-man carry. Either way, beware of spilling fuel. Moving the rest of the kit is just a straightforward, if rather heavy, carry.

6.1.2.5 Take care during erection; the bits are heavy and awkward and need to be aligned quite accurately to slot together. Make free with the grease and oil.

6.1.2.6 The mast must be vertical and the front of the base 4 to 6" (100-150mm) from the edge of the lock. Do not use bricks for levelling - they tend to crumble at just the wrong moment, as do the softer types of stone. If possible, level the site by digging out/infilling the back of the area to level with the top of the coping stones. Otherwise, use the minimum number of large pieces of timber under the stand. Once erected, put plenty of weight on the back of the frame to counterbalance the load, making sure it won't fall off if anything moves. Concrete blocks – the solid type – are ideal but stones, steel or even heavy timbers such as railway sleepers are fine. The 'gantry' type usually

come with fitted weight boxes and purpose-made weights. Keep an eye on the solidity of the base throughout operations; if it starts to rock, re-pack as necessary.

6.1.2.7 Jib angles are adjustable by means of bolts through alternative sets of holes. The middle setting is usual. It is, however, a trade-off. The lower the jib, the further the barrow hangs from the lock wall and the easier it is to raise/lower. However, it also hangs lower when fully raised and is thus harder to swing for landing. Rig very carefully with the engine stopped, oiling any moving parts. Then run the hook slowly down and back a few times to make sure everything is working correctly and that the cable is long enough. When fully extended there should still be three full turns of cable on the drum. Repeat this "down and up" test with a half load and then a full load with everyone well out of the way. If there are any problems, snagging on the chamber wall, rocking of the base, etc. then stop and solve the problem. Wear strong gloves when handling wire rope.

6.1.2.8 When you've completed the above and are ready to start the hoist, get someone to hold the jib when you pull the starter cord – to stop it swinging round.

6.1.2.9 With electric units ensure there is enough cable for unhindered swinging but not so much as to be a trip hazard. Protect the cable well if the barrow run crosses it.

6.1.2.10 There should be two personal accesses to the lock. If ladders are used they should be at an angle of 70° and project not less than 3' 6" above the landing. They should also be securely lashed, not only to something solid to stop them falling over but to each other if of an extension type because these come apart rather easily when manoeuvred from above.

6.1.3 Using the Hoist

6.1.3.1 Because this is a lifting machine the operator must have reached the grand old age of 21 – as should anyone connecting the load.

6.1.3.2 Hoists are not to be used as man lifts.

6.1.3.3 Barrows are suspended from hoists by purpose-made chain sets, comprising two chains of equal length terminating in rings about 2" (50mm) in diameter and a longer one terminating in a 'pigtail', all joined to a large ring which clips into the hook of the hoist. The 2" rings are first slipped right down over the barrow handles so that the chains pass outside the rear of the body; the pigtail then slips round the barrow frame (either side) in front of the axle and its chain rests over the front of the body. Do not shorten chains by knotting; they will be damaged. If they appear to be too long there is probably another reason. Find out what it is.

6.1.3.4 These machines are operated by a single lever (*Saga*) or linked pair of levers (*Ace*). In both, the method of operation is that the winding drum is automatically braked in the "At Rest" position (lever/s released) and both thus fail "safe". At the opposite end of the lever's travel (against a spring) the drive is engaged. In the middle is a freewheel position. Controlled lowering is achieved by balancing freewheeling and braking. Never try to balance (slip) the drive to hold a load stationary.

6.1.3.5 Once the first barrow is attached, it is ready to be lowered into the lock. Lift it a few inches, taking care that the pigtail doesn't slip, swing it over the edge of the lock, keeping it parallel with the side, and lower it steadily until it is 2-3' above the surface of the infil. Then stop and lower it very gently until it reaches the surface. In the early stages of a clearance, when the surface may be very uneven, it may be helpful to keep the barrow suspended a couple of inches above it. This makes loading easier by keeping the barrow level and prevents the pigtail's slipping by keeping it under tension. Before slewing the unit round check that nobody or nothing is likely to be knocked into the chamber. If you have to wait before lowering a barrow, keep the empty barrow slewed over the land rather than space.

6.1.3.6 Lifting a loaded barrow is straightforward but requires care. In particular, the lie of the chains and the fit of the pigtail must be checked and, if necessary, corrected. Then, any slack in the cable and/or chains must be taken in carefully to avoid slippage of the pigtail. The most common problems with barrow hoists are the incorrect fitting of the chains and/or slippage of the pigtail. Either can lead to the potentially dangerous spilling of the load. Like lowering, lifting should be done with the barrow parallel to the lock wall to reduce the chances of its catching. There is usually little to spare on height so you must be ready to stop quickly when the pulley block is 1-2" from the jib. Letting go of the control lever is all that is required but this is counter instinctive so takes a little getting used to. Keep both cable and chains untwisted. Either can lead to difficulty controlling the raising/lowering of barrows and may prevent their being lifted high enough to land at the top.

6.1.3.7 The *Saga* unit has only one control handle so offers little choice of technique; on the *Ace*, however, it is usually easier to take up slack using the front handle (better view) and then use the rear one for the actual lift (more leverage). Lowering is more easily controlled using the front one. Electrical units, particularly those without pendant controls, are to be treated with care. Most only fail safe when the block reaches the top.

6.1.3.8 All lifting and lowering should be done with the cable vertical. Barrows loaded some way along the chamber should be pushed to directly below the hoist before being lifted. It is debatable whether it is better to move the hoist along the lock side and keep altering the barrow run or leave the hoist in one place and have more than one barrow at the bottom at any one time. A combination of the two is probably the most common solution.

6.1.3.9 Hoists are designed to lift only 5 cwt (*ca* 250Kg). This includes the block, chains and barrow, not just the spoil removed. They should not be overloaded by, for example, trying to lift half-buried bits of metalwork or gate timbers.

6.1.3.10 If you run out of fuel while lifting a full barrow, do not panic. Simply release the control lever, braking the load; then lower it gently back into the chamber.

6.1.4 Ancillary Operations

6.1.4.1 Much of the skill of lock clearance lies in good hoist operating and working as a team. Slick barrow changing can easily halve the time taken to empty a lock. They key is always to use two people to switch the chains between barrows so that they are always

held and cannot tangle. If incorporated into the barrow-run cycle, helping the hoist operator do this can afford welcome, regular 'breathers'. If the site permits, the optimum technique is to 'land' the full barrow alongside the empty one, the helper removing the pigtail first, followed by the operator removing the rings, these actions then being reversed when putting the chains onto the empty barrow.

6.1.4.2 The physical demands of the barrow-run have already been mentioned. The following tips may help.

- Use pneumatic – rather than solid-tyred barrows and keep the tyres well pumped up. This makes them much easier to push
- Remove debris from between the wheel and the body. Otherwise, it's like pushing a vehicle with the brakes on
- Load most of the weight at the front of the barrow. The wheel then carries most of it rather than the arms of the poor sod who is pushing
- If the barrow run ends in a distinct edge, e.g. tipping from a platform into a dumper, use a heavy block to tip against and thus avoid running off the edge.

6.1.4.3 As regards the actual digging, the key is to get down to the invert (bottom) in one place as quickly as possible and then shovel off the invert. This is much quicker and easier than attacking the top along a whole length. Pull down compacted material with a mattock onto the invert ready for shovelling. Once you get to the invert and start moving along, you may need to use two or more barrows at the bottom. Slick changeovers are again important, the best way being to position the full barrow directly below the hoist and next to the wall, guiding the descending empty one to the outside of the loaded one, using shovels. Two people then swap the chains while a third takes the empty for loading. Meanwhile, if four shovellers re-load their shovels during the changeover, they will be halfway to filling the next barrow.

6.1.4.4 Depending on the nature of the spoil it may well slump overnight and so the following day it will appear that you have lost ground. You haven't and you will quickly pass where you left off the night before. It's just a bit disheartening.

6.1.4.5 As far as is practicable, keep clear of any lifting operations.

6.1.4.6 The invert usually (but not always) has a shallow U-section. Consequently, if you need to walk along a flooded chamber, try walking along the edges. They should be shallower, at least until you get to the gate recesses. It should be noted, however, that the standard depth of water on any restoration site is always wellie plus 1".

6.1.4.7 Stones are heavier than you think. One method of loading them into barrows is to put the barrow on its side, then roll the stone into it before carefully righting the barrow and centralising the stone over the wheel. Make sure the barrow has a well inflated tyre; soft ones tend to pop off the rim. Once you have loaded your barrow with stone don't fill up the barrow with sludge. It will be heavy enough as it is.

6.1.4.8 There is nothing to say that everything coming out of a lock must be in a wheelbarrow. If it makes sense, use just the chains – or ropes, or any other safe means ('stone tongs' are specially designed for lifting large stones) to secure the load. But do make sure it is secure and work out how you are going to handle it at the top before it gets there.

7. MISCELLANEOUS PLANT

7.1 Tractors (including tractor-mounted winches)

7.1.1. General Description and Preparation for Use

7.1.1.1 Tractors come in all shapes and sizes, from small 'Garden' types to monster, truck-sized beasts. Most are diesel-powered, though there are other types, notably Petrol and TVO (Tractor Vapourising Oil – a form of paraffin – now largely obsolete).

7.1.1.2 One of their main claims to fame is that they are usually fitted with Power Take-Offs (PTO's) so are capable of driving a range of ancillary equipment. This makes them useful for many tasks including:

- Towing graders
- Heavy rolling
- Grass cutting
- Hedge trimming
- Winching

7.1.1.3 Their other main advantage over other pieces of plant is that they can be used both on and off the road, including towing over short distances.

7.1.1.4 The main pre-operational checks on tractors, in addition to those already mentioned, are:

- Hydraulic fluid level (see 3.1.1 for description of the results of not doing)
- Brake and clutch fluid levels
- Ensure that, when released, all control levers return to their neutral positions
- If applicable, go round all the grease nipples with a grease gun

7.1.1.5 **Notes**

- The stop control may be on the key switch or, more likely, a manual "pull to stop" knob/cable
- Before starting, make sure the tractor is not only out of gear but that the PTO is disengaged
- Cold starting could involve either an excess fuel device or electrical pre-heaters (usually controlled by the key switch) or possibly both
- Always fully depress clutch and hold down whilst engaging starter.

7.1.2 In Use

7.1.2.1 While operating the tractor ensure adequate room is available between the machinery and other workers. Do not rely on others to "get out of the way"!

7.1.2.2 Great care should be taken on uneven and sloping ground, especially when loaded.

7.1.2.3 You will probably find two gear levers. One of these will operate the standard gearbox, whilst the other operates the High/Low transfer box, effectively giving you two sets of gears. It is important to note that most tractors do not have synchro-mesh. Therefore, unless you are uncommonly good at double de-clutching, you should not attempt to change gear whilst the tractor is in motion. When selecting a gear it is important not to overload the engine. An easy check for this is to open the throttle, if the engine picks up speed quickly there is no problem, if the engine does not respond it is overloaded and a lower gear should be selected.

7.1.2.4 There will usually be a method for braking each side of the tractor individually thus enabling a far tighter turning circle when working in restricted areas, this facility should not be used at anything above a "crawl" speed. This may be either twin brake pedals linked together with a clip, or one main and two additional brake pedals. If it is of the former type ensure the clip links the pedals together securely.

7.1.2.5 It is important to note that tractor brakes are not usually as efficient as those on cars, etc. Since most tractors weigh over two tons and the brakes are usually not power-assisted, caution should be the watchword. A rule of thumb when driving a tractor on the flat is that if you need brakes you are probably going too fast. (See also Parking.)

7.1.3 Power Take Off and Hydraulics

7.1.3.1 There are several different types of PTO but the only one likely to be encountered is the splined shaft at the rear of the tractor. This is used to provide rotary power to implements. It can be used whilst the tractor is mobile or stationary. It is important, nay, obligatory that the PTO and all associated shafts are properly guarded!

7.1.3.2 Hydraulics operate such attachments as fore end loaders, hedge cutting equipment, light excavating equipment and other implements fitted to the rear three point linkage.

7.1.4 Mounting Implements

Implements will either be mounted on the three point linkage or attached to the towing hitch, it is extremely dangerous to tow from the top of the three point linkage. Ensure that all three point linkage equipment is mounted correctly prior to use. If a pin hitch is being used for towing ensure the pin in use is adequate for the job.

7.1.5 Parking

You should not rely on the parking brake to keep the tractor from rolling away. If a mounted implement or fore-end loader is being used, lower it completely to the ground. As well as the usual safety reasons for doing this, it will also act as a second brake. If the tractor MUST be left on a slope and there is no implement or fore-end loader fitted, always chock the wheels.

APPENDIX 1 – ADDRESSES

WRG Plant Manager Part 2
Malcolm Bridge
3 Heather Bank
Littleborough
Lancs
OL15 0JQ

WRG Plant Manager Part 1
John Palmer
53 Southwood Road
Great Moor
Stockport
SK2 7DJ

IWA/WRG Head Office
3 Norfolk Court
Norfolk Road
Rickmansworth
WD3 1LT

APPENDIX 2 – WRG PLANT LIST

So what plant does WRG actually have? This list represents a snapshot in time of the wrg plant fleet and is only included to show the fact that at anyone time only about 75% is working and most of that is on long-term loan. However, if it is available then you can have loan of it for the cost of transport, maintenance and consumables. The list was undoubtedly out of date when it was printed so please contact the WRG Plant Managers for further details.

WRG Plant List as at 1st December 1997

CLASS'N	CODE	DESCRIPTION	REG'N NO.	LOCATION	SINCE	AVAILABILITY
Air Equip't	A 1	Compair/Ford 2 Tool Compressor		Worcester	09/09/93	IW
Air Equip't	A 2	Williams & James Static Compressor		NCCC	02/05/88	AV (on loan from AG)
Air Equip't	A 3	CP9 Air Hammer (small)		Mansfield	??/??/94	
Air Equip't	A 4	CP117 Air Hammer (large)		Mansfield	??/??/94	
Air Equip't	A 5	Poker/Vibrator		Mansfield	??/??/94	
Air Equip't	A 6	Air Drill		Mansfield	??/??/94	
Air Equip't	A 7	Air Hammer (large)		Mansfield	??/??/94	
Air Equip't	A 9	Poker/Vibrator		NCCC	10/12/94	AV
Boat	B 1	Work Punt, 34'	BWB 74422	Aston	16/07/89	LT
Boat	B 2	Aluminium Pontoon, 17' 6"		Droitwich	21/12/36	L) Not to be
	B 3	Aluminium Pontoon, 17' 6"		Droitwich	16/02/83	L) separated
Dumper	D1	Winget 2S, 15cwt		Grantham	??/05/96	L
Dumper	D2	Winget 2S, 15cwt	GKX 206 Y	Sankey	??/??/97	L
Dumper	D 6	Winget 2S, 15cwt	MMA 897 L	Boxwell Springs	09/02/93	L
Dumper	D 7	Winget 2S, 15cwt	Q 742 FLD	Wilts & Berks	12/08/89	L
Dumper	D 8	Benford, 15cwt		Langley Mill	??/11/79	LT
Dumper	D 9	Bonsor, 15cwt		Langley Mill	??/??/87	L
Dumper	D10	Bonsor, 15cwt		Chesterfield	10/10/87	L (non-standard colour)
Dumper	D11	Benford 750, 15cwt		Elsecar Basin	23/0B/90	AV (in use till wanted)
Dumper	D12	Benford 750, 15cwt		Sankey	??/??/97	L
Excavator	E 2	JCB C2	CWT 167 H	NCCC	15/12/94	IW
Excavator	E 3	Smalley 5, Mk.2, with winch		Stockport	22/11/90	BD (needs a lot of work)
Excavator	E5	Smalley 5, Mk.3		Wilts & Berks	??/06/89	L
Excavator	E 7	RB3, 360° Excavator		Langley Mill	??/10/79	LT
Excavator	E11	Case 1835B Uniloader		Aston	03/97/88	L
Excavator	E12	JCB 803		Aston	30/04/97	L
Gardening Equip't	G 2	Echo Bruish Cutter		NCCC	22/11/95	AV
Gardening Equip't	G5	Husqvarna G165		NCCC	07/10/97	AV
Lifting Equip't	L1	Tirfor T35, 3 Ton Winch		Test House	13/10/95	BD (a lot of work)
Lifting Equip't	L2	Ace Barrow Hoist		NCCC	05/12/95	AV (to be tested)
Lifting Equip't	L 3	Jones KL15, 15cwt Crane	JXM 31	Elsecar	08/03/94	L

Lifting Equip't	L 5	Saga Barrow Hoist		NCCC	04/06/97	L
Lifting Equip't	L 6	Yale 3 Ton Pull Lift (6' lift)		Northwich	07/06/91	L
Lifting Equip't	L 7	Yale 3 Ton Pull Lift (6' lift)		Northwich	07/06/91	L
Lifting Equip't	L 8	Yale 3 Ton Pull Lift (6' lift)		Stockport	06/01/91	AV
Lifting Equip't	L 9	Yale 3 Ton Pull Lift (6' lift)		Aston	29/06/92	L
Lifting Equip't	L10	Yale 3 Ton Pull Lift (6' lift)		Stockport	06/01/91	BD
Lifting Equip't	L11	Tirfor T35, 3 Ton Winch		Cotswolds	14/04/97	L
Lifting Equip't	L12	Tirfor T35, 3 Ton Winch		Buckingham CS	11/02/96	L
Lifting Equip't	L13	Tirfor T35, 3 Ton Winch		BITM	05/12/95	L
Lifting Equip't	L14	Tirfor		Camps		
Mixer	M 1	Ransoes, 5/3.5		Langley Mill	??/10/79	LT
Mixer	M 3	Small Wheeled		Worcester	29/12/90	IW; DL
Mixer	M 4	Belle Electric, 110V		Grantham	01/04/96	L
Mixer	M 5	Belle Petrol		Diggle	??/10/85	L
Mixer	M 6	Belle Petrol		Wilts & Berks	26/12/88	BD (New Engine Sent)
Mixer	M 7	Liner/Petter		Aston	26/05/91	L
Mixer	M 8	Belle Electric, 100V		Aston	14/06/97	L
Mixer	M 9	Small Wheeled		Macclesfield	13/01/90	L (Macclesfield CS)
Mixer	M10	Johnson/Petter poker		NCCC	07/11/95	BD (drive cable)
Mixer	M11	Stihl TS350 Super, 12" Bricksaw		Aston	16/07/97	L
Pump	P 1	Lister/Sykes 3" Centrifugal		NCCC	04/12/94	AV (detail work req'd
Pump	P 3	2" Centrifugal, Petrol		Stockport	20/04/85	AV (short term)
Pump	P 4	Johnson Mk 18, 3" Petrol		NCCC	07/10/95	AV (minor oil leak)
Pump	P 5	Lister/Johnson Mk4, 3" Sludge		NCCC	21/09/95	AV
Pump	P 6	Lister/Johnson Mk4, 3" Sludge		Wilts & Berks	19/05/95	STOLEN
Pump	P 7	Simplite 2" Sludge, Petrol		NCCC	28/03/97	AV
Pump	P 8	Weda 2" Electrosub, 110V		NCCC	05/11/92	IW (contactor dead)
Pump	P 9	Borehole, 6" 3PH		NCCC	27/02/96	AV
Pump	P10	Lister/Sykes 4" Fast Tow		Wilts & Berks	10/05/05	L
Pump	P11	Lister/Sykes UVC6		NCCC	27/02/96	L (minor work req'd)
Pump	P12	Lister/Sykes UVC4		Hereford & Gloucs	05/07/96	L (minor work req'd)
Pump	P13	Johnson Mk3(?), 3" Sludge		Elsecar	27/07/92	L (minor work req'd)
Pump	P14	Spate/Petter 3"		NCCC	21/02/95	AV
Pump	V 3	SLD. 6" Dri-prime		Aston	03.04.97	L
Pump	V 5	2" Atalanta/Petter		NCCC	??/??/94	AV
Trailer	T 1	Plant Trailer, 16' x 16' Deck		NCCC	07/11/95	BD (to be scrapped?)
Trailer	T 2	Caravan 20" Site Hut		Droitwich	??/09/81	LT
Trailer	T 3	Box Trailer, 5'4" x 8'10", 2 Wheel		NCCC	07/11/95	AV (short term only)
Trailer	T 5	Camps Trailer				
Trailer	T 6	Horse Box Trailer		Aston	??/??/92	BD (to be scrapped?)
Trailer	T 7	16' Mobile Office		NCCC	21/05/91	AV (short term only)
Trailer	T10	Camps Trailer				
Trailer	T11	Bessacar 450 Caravan		NCCC	03/09/95	AV
Workshop Equip't	W3	Gas Welding Set		NCCC	23/03/91	AV (short term only)
Workshop Equip't	W6	Kew Pressure Washer		Aston	07/06/97	L
Workshop Equip't	W8	Generator, 6KVA, 110/240V		Aston	07/06/97	L (short term only)
Workshop Equip't	W10	Pressure Washer 3PH		Droitwich	20/09/87	L

Workshop Equip't	W11	Generator B&S 1kV, 240/110V		NCCC	20/03/94	BD (needs new engine)
Workshop Equip't	W12	Broomwade DD7G-13 Drill, 1/2" chuck		NCCC	11/07/89	AV (fittings)
Workshop Equip't	W13	Broomwade PK3A Grinder		NCCC	11/07/89	AV (needs sorting out)
Workshop Equip't	W14	Broomwade TSH3B Scrabbler		NCCC	11/07/89	AV (needs sorting out)
Workshop Equip't	W15	Broomwade BX7BA Chisel		NCCC	11/07/89	AV (needs sorting out)
Workshop Equip't	W16	Electric Drill 5/16" Chuck, 110V		NCCC	07/11/95	AV
Workshop Equip't	W17	Transformer, 240 > 110V, 500VA		NCCC	31/05/99	AV (short term only)
Workshop Equip't	W18	AEG WS2000S Angle Grinder, 7", 110V		NCCC	01/05/96	STOLEN
Workshop Equip't	W19	Transformer, 240 > 110V, 500VA		NCCC	03/08/89	AV (short term only)
Workshop Equip't	W20	Compair BW1017 Impact Wrench		NCCC	03/08/89	AV (fittings)
Workshop Equip't	W22	Transformer, 240 > 100K, 1kVA		NCCC	15/01/96	AV
Workshop Equip't	W24	Makita 5" Grinder, 110V		NCCC	01/05/96	L (short term only)
Workshop Equip't	W25	B&D 1/2" Drill, 110V		NCCC	01/05/96	L (short term only)
Workshop Equip't	W26	Richmond 6" Bench Grinder		NCCC	02/10/96	AV
Workshop Equip't	W27	Krypton Welder		NCCC	23/09/97	AV

Practical Restoration Handbook

Vehicles and Trailers

by
John Palmer and Mick Beattie

CONTENTS

1. INTRODUCTION

1.1 For almost all restoration groups there are certain subjects that crop up in conversation on a regular basis. One of the most common is "We should get a van", usually followed by either "We should get another van" or "We should get a trailer". It seems that almost any restoration work involves moving heavy objects or lots of people about. Given this it is hardly surprising that this is a classic grumble from the work site to the committee meeting. This chapter offers advice and guidance both to help you finish the argument and then to maximise the benefits of any vehicles and trailers.

1.2 This booklet is based on the considerable experience of the authors and from interviews with many waterway recovery group (WRG) volunteers. Hopefully it will enable societies to avoid the "potholes" of owning a vehicle and/or to maximise their safe and effective use. The authors realise that each society has different requirements and so this will not attempt to be too prescriptive a document. However, as many people reading this chapter will be WRG volunteers, or at least affected by them, any additional points that directly apply to WRG vehicles and trailers are given in Appendix 2.

1.3 One point needs to be made clear from the outset:

Vehicles and trailers are a considerable responsibility

1.4 Not just for a society's committee in terms of legality, depreciation, costs etc. but in very real practical ways for whoever is in charge of them at the time i.e. the driver. There is one golden rule imposed on WRG drivers –

Do not drive if you are unhappy about any aspect of the vehicle or it's use

1.5 You may be unsure about paperwork matters (is the MOT current?) or practical matters (should the brakes make that noise?) – either way check it out before you set off.

1.6 The simple reason for this is that it is your responsibility to ensure both the trailer and towing vehicle are legal, safe and roadworthy. "Well I assumed so" or "I asked Fred to check it and he didn't say anything was wrong" will not be acceptable to WRG, the insurers or the police.

1.7 Good though this chapter is, it is worth knowing that RoSPA, some Police Forces and some Local Authorities run driving courses specifically for charity minibus and van drivers. Consider getting a few of your volunteers together and attending a course – it may be a day well spent. In addition the guidance offered by the Highway Code should not be ignored.

2. VEHICLES

2.1 Running a vehicle/what sort of vehicle?

2.1.1 Firstly you need to consider what is the vehicle going to be used for. By far the most popular vehicle is the Ubiquitous Ford Transit van or any of its imitators. However, if your vehicle is for the use of a project officer visiting local interest groups to raise the project profile then perhaps a small economical van is the right answer. Similarly, if your restoration works demand it then

perhaps a larger wagon is what you want. (WRG have recently purchased a beavertail wagon to move plant and equipment around the country – we'll let you know how it turns out!).

2.1.2 There are other more direct factors that will influence your personal decision – if the Local Authority locks off all its access points with 6' height barriers then you would be fairly foolish to buy a high roof van. If your group of volunteers is small but needs to be mobile and carry equipment then a utility van (50/50%) may be the answer.

2.1.3 The desire to have a site capable vehicle often leads people off on a "perhaps a Land Rover instead of a van" argument. It cannot be denied that it is a nice idea to be able to drive to the builders merchant, load up with cement and then drive across site and deliver it straight to the mixer. To be able to tow your tool trailer to exactly where you want it is a dream shared by anyone who has had to manhandle one into place. However, be aware that the potential for accidents is considerable, driving them on site is a considerable skill and in the same way that dumper drivers should be properly trained so should anyone who will be using a vehicle off road. Also it must be said that the physical capacity of most 4x4 vehicles is quite small compared to a van, and certainly their personnel carrying facilities leave something to be desired. However, there have been many times that WRG have been very grateful for a Land Rover on site and if you are sure that you can use one it may be a sensible option. It may be you wish to have a vehicle for site use only: the Montgomery and the Stratford both ran non-roadworthy (but still safe!) Land Rovers for a while with great success. However, this is really only a sensible idea if your site is spread along a wide towpath for a mile or so or you have a large field or similar to work in.

2.1.4 Make no mistake the costs involved in running a vehicle can make a sizeable hole in your restoration budget. Although there are documented records of a WRG van only costing £50 a year to operate (not including insurance, MOT and tax), a modern van maintained to a high standard costs in excess of £1000 a year to run. There is also considerable depreciation and you will be prudent to start saving to replace a vehicle as soon as you buy it. Sponsorship may help the budget out but it is difficult to find.

2.1.5 Good maintenance is essential for the safety of everyone. Although no one is suggesting that every minor dent and scrape should be repaired immediately remember that you have a duty to the public and your volunteers. No volunteer should be expected to drive a van that is likely to breakdown and strand him in the back of beyond.

2.1.6 So even a brief analysis of the potential costs means that one discussion any responsible society needs to have (and keep in the back of their mind when costly repair work is required) is "would it be cheaper to hire each time?"

2.1.7 Hire versus buy is a fairly common argument and goes something like this:

Hiring:

- We can get the exact vehicle we want for each job (if it is available)
- We don't have to worry about its security mid-week
- Maintenance is not our problem
- It will be shiny and not break down at critical moments

Buying:

- It will be available on the Thursday evening to load up
- We can paint and signwrite to get some publicity and raise our local profile
- We can modify it so it will safely carry those long-handled slashers and rakes we have
- We don't have to find someone to pick it up before six on Friday
- We don't have to find someone to get it back after nine on Monday (more difficult)

2.1.8 Following on from the "hire versus buy argument" is the "diesel versus petrol" argument. As far as WRG is concerned there is no discussion – diesel wins every time; reliability, longevity, economy, lower fire risk, low revving, good on site with lots of torque for towing, lower depreciation but higher initial purchase price. However, If you are in the market for a cheap short-term vehicle then it will most likely be petrol.

2.1.9 For most of this booklet it is assumed that the vehicle chosen is a standard "box" van (possibly as a people carrier). However, many of the points will still be valid for 4x4s, mini-vans etc.

2.2 Fuel, Tyres, etc.

2.2.1 Always make sure that you put the right fuel in the vehicle. If a diesel-engined vehicle is to be run on the highway at any time then it must be run on white diesel (also known as DERV fuel, which actually stands for Diesel Engined Road Vehicle). White diesel has to meet stricter environmental specifications but the only visible difference between red and white diesel fuel is that red diesel has some red dye in it. White diesel carries a tax which takes the price from £1 to £3.50 a gallon. The red dye is therefore a technique used by the Tax inspectors to ensure all road fuel is taxed. They are entitled to stop and check fuel tanks at random roadside stops. The dye stains the tank for many months and so they know if any red diesel has been used recently. They have regular "purges" in most areas and if you are caught with red diesel in your tank you will be prosecuted. If you are caught with evidence (stains) of red diesel then you will be in a long legal argument about "it wasn't me Guv, it must have been someone else, how was I to know, etc". You may well get away with it (or they may well prosecute the society itself) but it is not something you wish to occupy your vital restoration time with. So the moral is don't use red diesel, always use legal white DERV fuel.

2.2.2 Never ever run out of diesel fuel, diesel engines can be a real pain to bleed through. If you are leaving the van for some time during the cold weather then do so with a full tank to prevent water condensation and waxing in the fuel tank.

2.2.3 If the vehicle has a petrol engine and was designed to run on leaded petrol then you might find you need to have the engine modified if you intend to use it for heavy motorway driving or for towing. This involves having hardened valve seats fitted.

2.2.4 All spare fuels should be stored in proper containers and label them to avoid the old "Well, I thought it was blackcurrant squash" mistake.

2.2.5 A good quality engine oil is recommended, a cheaper one is often a false economy.

2.2.6 Chcek the condition of the tyre, they should be free from cuts and defects. Also check the tread, the limits for vehicles under 3,500Kg maximum laden weight are:

• Cars, light vans and light trailers MUST have a tread depth of at least 1.6mm across the central three quarters of the breadth of the tyre and around the entire circumference

• Motorcycles, large vehicles and passenger carrying vehicles MUST have a tread depth of at least 1mm across three quarters of the breadth of the tread and in a continuous band around the entire circumference.

2.2.7 All of these considerations apply to the spare wheel(s) – check them before you need them. And while we are on the subject make sure you know where the jack and wheel brace are stored.

2.2.8 Bulbs, fuses and other such consumables – it is best to carry a stock of these and if you use them replace the spare immediately.

2.2.9 Keep washer bottles full as entrances and exits to worksites are often very muddy and windscreens need to be cleaned. Similarly if your windscreen wipers are in poor condition then replace them. A bottle of water carried with the vehicle will ensure you have something to top up the radiator and the washer bottles with.

2.3 Insurance/Legal

2.3.1 Firstly remember that the moment you take the vehicle off the highway it will almost certainly not be insured by the motor policy you are paying for. It is therefore necessary to take out additional plant insurance to cover use on site. Corporate members of the IWA can take advantage of cover given by the IWA policies. This places certain conditions on drivers. See PRH "Health & Safety Section 2" for further details.

2.3.2 One point that cannot be reinforced too much is that if you use the vehicle for hire or reward then a whole load of additional legislation concerning driving hours, tachographs, etc. become relevant. Also the insurance cover will almost certainly be void. Hire or reward has been interpreted as not only taking money from passengers but also receiving a donation towards fuel so be very careful about how you phrase such things.

2.3.3 Check carefully the contents policy. As mentioned in "security" below, it is the loss of the contents not the van itself that will cause the major problems.

2.3.4 Speed limits are also a source of much hearsay and untruths. They are also open to interpretation by the Constabulary. However, the generally accepted limits for close coupled trailers (which most are) are:

Vehicle	Single carriageway	Double carriageway	Motorway
Van/minibus	50	60	70
Single axle trailer	50	50	50
Double axle trailer	50	50	60

2.3.5 Do report all accidents to whoever is responsible and do inform the vehicle's keeper if you are stopped by the police.

2.3.6 Remember as the driver of the vehicle it is your responsibility to ensure the Tax and MOT are valid.

2.3.7 A further consideration is to ensure that the driver is actually legally allowed to drive the vehicle. This situation has been "fluid" over the past few years as UK legislation has moved into line with European rules. The automatic granting of permission to carry more than 8 passengers upon passing an ordinary driving test has been applied intermittently. Hence for people who passed their test recently they will need to individually check their licence. The critical category on the licence is D1/D. Check this before driving.

2.3.8 Whatever the case you will still need to be over 21 to drive a vehicle that can carry more than 8 passengers.

2.3.9 Make sure you know where your vehicle documents are kept. They may be kept in the van or they may be held centrally. If the police stop you and request to see your documents then, if not provided there and then, they must all be provided together at one nominated police station. Unless the driver can get to the head office (or wherever the rest of the documents are kept) then the driver will need to keep his licence with him in case he is stopped.

2.3.10 As this chapter was going to press there was a new development in European legislation. It appears that the mere act of fitting a towbar to a vehicle means that it is "modified to carry goods" and if it exceeds the minimum weight (max. train weight of 3.5T) then it requires a tachograph. This could well cause problems for many of us, WRG hope to have some guidance notes on the subject soon.

2.4 Control of Drivers

2.4.1 The subject of control of drivers is dealt with in PRH "Health & Safety Section 2". The authors seriously recommend that you put in place some regime to control who can drive your vehicles(s). The WRG Driver Authorisation scheme is highly recommended.

2.4.2 Even the most experienced driver should be given instruction before being allowed to drive an unfamiliar vehicle. The driver should have wide experience before being allowed to drive a vehicle with passengers. Any person driving should be completely familiar with that particular vehicle before taking passengers, and less experienced drivers should be limited to driving without rear passengers for a while. (N.B. Less experienced refers to the size of the vehicle – an experienced car driver still needs to learn to drive a large vehicle and cope with the limited visibility of a van.)

2.5 Safety

2.5.1 Beware the effects of fatigue. Canal restoration is a tiring business anyway and that coupled with the fact that you know twenty volunteers are waiting for you to get back from the builders merchant with the cement so they can start mixing can easily lead to reckless driving. And we know where that will lead, don't we? Don't give into the pressure.

2.5.2 Duty drivers – it is WRG policy, when staying in remote locations, to nominate a duty driver for the evening to do all the driving, both for social trips and emergency trips. Because this is sorted out at the start of the evening you do not have the embarrassing "I can't drive back, I've been drinking", "So have I", "So have I" conversations at eleven o'clock. It also means the volunteer knows exactly who to wake up if they are taken ill in the middle of the night.

2.5.3 A side loading door (SLD) has many advantages for a panel van as they make access to the load bay easier and give a second route to whatever vital bit of kit you have buried in the middle of the van. The mechanisms on older models used to be unreliable but modern SLDs are usually OK so long as the sliders are kept clean. An SLD is mandatory if the vehicle is used for towing with more than eight passengers in the vehicle (it's a good idea anyway).

2.5.4 Emergency exits – if the vehicle is to be used to carry passengers other than in the front seats then the emergency exits need to be marked appropriately. This is not quite the safety overkill that it seems – in the authors experience at least 50% of first time volunteers are incapable of opening the rear doors of a Transit from the inside!

2.5.5 Don't use mobile phones or two-way radios while driving (without a proper hands-free kit) because you may well crash. Conversations using hands free equipment can distract your attention from the road. If you receive a call, say you are driving and keep the conversation brief. They must also be switched off whilst in fuel stations.

2.5.6 Fire extinguisher – this is obviously a sensible item to carry, but ensure it is correctly fitted and checked regularly.

2.5.7 First Aid kit – whether mandatory or not it makes sense to have a decent first aid kit on board. Avoid the "travelling/buy them at a garage" kits – they are of very little use. Get a proper one (HSE approved for 10-20 people), that way if you have a working party that travels with the van they are all covered (assuming the van doesn't leave site). And as with all first aid kits if you use anything out of one then tell the person responsible so they can replace it. That way next time it's required.....

2.5.8 If the van is to be used to carry any hazardous substances then check the Hazchem regulations. The most common item that falls under the regulations is bottled gas. Warnings may need to be displayed on the outside of the van.

2.5.9 WRG retains a breakdown recovery service so that no matter where the van breaks down the passengers and the vehicle can be recovered and fixed. You may not feel the need for such extravagance (after all your van never breaks down and never travels more than 10 miles from base, does it?)

2.6 Loading

2.6.1 Beware of unsecured equipment – lash it down properly. It is recommended that a suitable bulkhead is fitting to avoid the load shooting forward and injuring the driver/passengers. Before you set off try an emergency stop in the safety of the car park to see how the load stays put and how the brakes are affected.

2.6.2 It is well worth fitting a panel van out with proper racking and straps (Surrey and Hants Canal Societies van is a good example of cramming it all in).

2.6.3 Don't overload the vehicle and ensure the load is distributed evenly to maintain steering – stick 40 bags of cement on the very back end of a van and you will see how the front end is lifted off the ground making steering poor and unresponsive.

2.6.4 Don't bury the spare tyre or the jack and wheelbrace under the load or you will guarantee getting a puncture.

2.6.5 Don't drive around with loads sticking out of the back, unless properly lashed and marked (and suitably lit at night).

2.6.6 Pick up trucks – these can be very, very useful but if you are shifting a load of dusty or loose materials then please remember it is a legal requirement to sheet the load over.

2.6.7 Roof racks – these have the advantage of keeping the kit out of the body of the vehicle but they do drastically raise the vehicles centre of gravity (and reduce its stability and cornering) and also increase wind resistance and reduce its fuel economy.

2.7 Minibuses and Passengers

2.7.1 For many years the restoration movement travelled round in vans with everybody crammed in the back sitting on whatever they could find that was comfortable. As time progressed the vans were fitted out for a convenient mix of people moving and goods moving. This usually meant bench or box seating and, apart from the fact that whatever was urgently required was usually in the box seat that had three navvies and 8 bags of cement on it, worked very well.

2.7.2 However, a constant drive towards safety meant that legislation was threatened that would make such seating illegal. Only properly installed "crash tested" seats with seat belts would be legal. At the time of writing it seems that this has not fully happened (except for under 16s).

2.7.3 However, recent accidents and the uproar that followed mean that, in the authors opinion it would be very foolish to purchase a vehicle without seatbelts and proper forward facing seats.

2.7.4 Hopefully it is obvious that if they are fitted, passengers should always use the seat belts, even for short distances. If seat belts are fitted in the vehicle the driver should tell the passengers to put on their seat belts at the start of every journey. There should be one passenger only per seat. If any seats are removed to increase the load space they must be re-installed by a competent person.

2.7.5 If you have a 15 seat minibus it will require a Class 5 MOT – it is very difficult to find a garage that can cope with Class 5 but remember that most public bus companies have facilities and will take outside customers if not busy. The cost is only slightly more than a normal MOT.

2.7.6 With regard to actual driving there are only a few extra suggestions. Don't underestimate the noise and disruption a van full of navvies can produce (especially on the way home from a pub). If they are distracting you stop and tell them to sit down and shut up or they will be walking. You are in

charge. Any passengers reading this should think hard before starting that boisterous sing-song at midnight; there is one person in the van who has had to drink lemonade all night and is now having to navigate the dark country lanes in the rain. Be kind to them. Shut up. Or walk.

2.7.7 The biggest headache with driving people about is checking you are leaving with all the people you brought. Count them out and count them in again. If you are part of a several van convoy check with the other drivers to ensure you are not waiting for someone who went in the other bus some time ago.

2.7.8 And finally, just remember that they have been working hard and are tired and don't want to be flung about the back of a bus. Drive with due consideration for your passengers, they do not have a steering wheel to hang onto!

2.8 Security

2.8.1 Security is, unfortunately, an important issue these days. It is not so much the cost of replacing the vehicle (that is what insurance is for) but the sheer inconvenience. What are you going to do all weekend if someone nicks your van full of expensive tools and unique coping bricks? How are you going to get back to Sheffield from Oswestry at 8 o'clock on a Sunday night? Thus be careful about how and where you leave your van. Avoid shouting across the pub "Dave, I've hidden the keys to the van in the back wheel arch".

2.8.2 You may wish to consider tinted windows (though this may well attract attention and all of the vehicle's original windows must allow at least 75% of light to pass through them) or consider a "no power tools stored in van" sticker. Additional features such as immobilisers and steering wheel locks are a worthwhile investment.

2.8.3 Regarding keys there are several WRG traditions as to what to do with them, obviously they are not for discussion here and please, once you have discovered them, don't tell everyone you meet.

2.8.4 Never leave vehicle documents in the vehicle.

2.9 Driving Techniques

2.9.1 Before you drive off don't forget all the usual checks – oil, fuel, water, tyres, lights, etc.

2.9.2 Compared to your car it's wider, longer and the wheels are in different places so it will handle differently, you should get some practice in before going on the road.

2.9.3 Take all corners late/wide to avoid clipping the corner (and the pedestrians, their dogs, pushchairs, etc).

2.9.4 Get in the habit of pulling up to T-junctions "square" so that you can see both directions of traffic. This is good practice in a van with side windows and essential in a panel van.

2.9.5 Do adjust the mirrors and seat so they are relevant for you before you set off.

2.9.6 Unless your normal vehicle is a Morris Minor Traveller it is a fair bet that the van will have a lower power to weight ratio than you are used to. Even when unloaded it will take more time to pull out at junctions, when loading or towing it will takes ages to pull out into traffic and you will need to drive appropriately.

2.9.7 You will also notice an increase in stopping distances.

2.9.8 There is no shame in getting out and having a look before you hit the wall when manoeuvring.

2.9.9 Remember you are in charge even with 14 drunk navvies in the back of the vehicle.

2.9.10 Clean your muddy site boots and take off your muddy gloves before driving.

2.9.11 Remember that, unlike you, your passengers don't have a steering wheel to hang on to so slow down if they are starting to roll about.

2.9.12 Proper driving techniques (just like the ones you passed your driving test with – don't hold things on the clutch, use the handbrake etc.) will save valuable pennies and save on down time.

2.9.13 Regarding driving on site – the easiest way to avoid problems is DON'T but if you must then use 2nd gear and low revs with nobody hanging on the back.

2.10 Parking

2.10.1 Ensure that when parking you take the time to manoeuvre it so it is ready to leave easily (unless loading considerations or similar apply). This is especially important if the vehicle is the emergency vehicle (WRG policy is to always have a vehicle available on site ready to go to hospital or wherever in an emergency). Not having to turn the van round with a 64 point turn is a blessing when you are trying to go home and you are tired, weary and it's dark. It is a real essential when someone has just had an accident and needs to get to hospital fast.

2.10.2 When backing up to a wall consider access and egress from the rear doors and park a distance from the wall.

2.11 Cleanliness

2.11.1 The first thing to remember is that the van represents your organisation. With appropriate signwriting it can be good publicity (Contract Sign Services will make up some smart stickers for you). So keep the van looking clean and respectable and people will respect you. If you have just bought the van then consider a respray to your societies colours, it may only cost a few hundred pounds but may well make the van look like a million dollars.

2.11.2 You may wish to consider wipe-clean seat covers, these are available from Atlantechs Ltd at Weedon amongst others.

2.11.3 One final point is that if you are going to use the van for an evening social trip to the pub then it is far easier to clean it up just after you get back from site rather than when you have all eaten and

changed into your clean clothes. It is strongly recommended that you carry a brush in the van for just this sort of thing.

2.12 Green Van-keeping

2.12.1 These days no society can expect to be considered environmentally responsible if they drive around in an oil-burning old wreck. When purchasing a van you should consider such green issues.

2.12.2 Also consider disposal of waste oil, tyres, etc. Oil can be recycled or used to start fires on site, old tyres can be given to boat clubs as fenders. Beware, however, waste oil is carcinogenic and should be properly disposed of.

2.13 Paperwork matters

2.13.1 You should always give your drivers access to the information they need, it will save time and trouble, probably just when you need it most. In the glove box of each WRG van there is a red information folder – this has all the information drivers need regarding:

- MOT/TAX info
- vehicle dimensions
- max. number of passengers
- other restrictions on use
- insurance details
- maintenance notes
- general WRG info

If it's your first time in a particular vehicle then read the folder. Do not remove it from the vehicle.

2.13.2 A sample copy of the WRG version is available from the WRG Transport Manager. Adapt it to your needs and use it. An abridged copy is stuck to the visor of all the WRG vans for quick reference by the driver.

2.13.3 Take the time to carry out a complete audit of the van's condition every now and then as appropriate. During the Canal Camps season WRG Logistics ensures that a check is made at the start of every camp. This ensures that dents are checked and that any maintenance problems (i.e. burning oil) are flagged up in time and means we can trace who scratched what. The Logistics checklist is given in Appendix 1.

2.14 Hints and Tips

- Remember that speed limits are exactly that – "they are a limit not a target".
- Don't suddenly turn on the fan full blast or you'll most likely be covered in the dust that builds up everywhere in a site van but especially in the air vents. Turn it on gently to avoid a blinding shower.
- Vans are a great place for romantically inclined couples – when you jump in the van first thing in the morning remember to check who is in the back before you set off for site.

- It is often the case that lots of keys can lock a vehicle but only the right one opens it. The author can testify to locking the van up securely only to notice the correct set of keys still in the ignition of the now unopenable van. Keep spare copies of keys and know who has the spares.
- Number plates suitable for fitting to a trailer should be kept with the vehicle if it is suitable for towing. WRG policy involves storing them in the glove box when not in use.
- Crushed wings/wheel arches and battered corners of vehicles are often a result of people not using their wing mirrors. Mr Beattie suggested removing the rear view mirror to force people to use their wing mirrors. WRG did this and by golly it worked, most WRG drivers use their wing mirrors a lot more and dents were reduced.
- Brake pads are cheaper than gearboxes!
- From bitter experience most WRG drivers know that it is better to have as many wheels as possible (4 being a minimum!). Transits used to be twin rear wheel (giving six wheels in total) this gave more traction on site (but meant there was more chance of a puncture). Unfortunately most new vans now only come as four wheelers as the twin wheel arches were deemed to intrude into the load space too much. However, they are still available second-hand.
- No matter what various smart alecs say do not leave the vehicle in gear when parking up unless you really need to as a brake. And when starting a van ensure it is in neutral before you turn it over..
- Remember your driving licence.
- Rubbish on the dash board – don't tolerate it. It will obscure your vision and is a driving hazard.
- Always ensure all the doors are shut before you drive off.
- On a lot of current vans the fuses work loose over a period of time, so if an electrical feature stops working check the fuses first and give them a bit of a waggle.
- Check heights, widths and lengths of the vehicle before you set off – it's a lot easier than holding up the traffic at the entrance to the railway station car park while you get out and measure the van. WRG vans have a notice inside the van giving such details (see Appendix 1).
- When travelling on convoys put the slowest vehicle first. It stops that driver having to flog his van to keep up.
- Keep publicity leaflets in the van – the author has been stopped on the Euston Road by a motorcycle courier who wanted to know what we were all about.
- Fuel gauges, speedometers, etc. all read different – check with the vehicle keeper as to what each actually means. Best to refuel as soon as the needle hits the red section.
- When driving large numbers of passengers around always count the number of passengers who get out of the van and ensure the same number get back in before setting off again. And if you take anyone else back who came in another van then tell the driver of that van so he doesn't have to spend ages looking for a bloke who is actually already back at the accommodation.
- Before you drive off check the rear of the van for tools, etc. leant against the vehicle and tea mugs stacked on the rear bumper. Also check the passenger side of the vehicle as driving off with a rake leaning against the side door will produce a really nasty scratch all along the body.
- This is a very obvious point but never drive off in the wrong van. It might not matter to you which van you go to the builders merchant in but it might matter to the site leader, cook, etc.

- Another common error is to drive off in one van with the keys to the other van still in your pocket – an easy way to become very unpopular.
- Check that the number plates match if you are towing.
- Let the leader know you have taken the van and when it will be back as it will save an awful lot of grief. It may be the leader has an important job for the van, which is why it has been cleaned out and left ready to go, not so you can nip to the newsagents in it.
- Vans (especially with trailers attached) are difficult to manoeuvre so to avoid having to reverse up the country lane for two miles it is best to look at maps before setting out.
- As mentioned before six wheelers have much better traction on site but one problem is that it is possible to get a single flat tyre and not realise it as the other one of the pair holds it up. Always check with a firm kick that all tyres are inflated. An allied problem is that half bricks and rocks get caught between the twin wheels. Once this has happened two outcomes are possible – either the brick stays there and writes both tyres off or the brick ejects itself at 30 mph and damages the windscreen of the guy behind you. Both cases are not good news so before you leave site check for objects between rear twin wheels.

3. TRAILERS

3.1 Introduction

3.1.1 Trailers in particular are excellent "learn by watching others make a mess" plant. Watch all the other people with interest. Weigh up what you see carefully:

- is it safe?
- is it peculiar to that unit?
- is it an accident trying to happen?
- can we learn from what we have seen?
- what if?

3.1.2 But, however much practice you get (and that is never enough!) the only time you get it right first time is when there is all the time in the world, all the space you could want and not a soul watching!

3.1.3 Every Minibus passenger seat must have unobstructed access to at least two doors, one of which must be on the near side of the vehicle and one of which must be either at the rear or on the offside of the vehicle for passenger use. There is a risk of blocking such exits by towing a trailer and minibus operators and drivers should be made aware of this fact.

3.2 Connecting Up

3.2.1 **Safety**

- Keep your feet out from under the A-frame when connecting up – it is not unknown for legs, jockey wheels, etc. to slip and delay your trip with a jaunt to the local Casualty Department. Be very careful about releasing the trailer brakes before the whole unit is

coupled up – on a slope the trailer may pin you to the vehicle or disappear into the distance.

- If the trailer has a reversing catch to stop the trailer brakes engaging when reversing then check the catch is disengaged and any brakes are free to operate. Many modern trailers have an automatic hitch that negates the use for a manually engaged catch.
- Do not use bricks, sandstone blocks or similar as chocks or supports for jockey wheels – they have a habit of pulverising.

3.2.2 **Procedure**

- Ensure the parking brake of the towing vehicle is applied.
- Remove the wheel clamps and hitch cover (if applicable).
- Check the weight distribution (especially nose weight).
- Couple the main hitch (check the hitch height is set correctly). Se also 3.4.2
- Connect the breakaway cable (ideally to a separate part of the vehicle).
- Wind the jockey wheel, rear legs, etc. fully up, raise them into the storage position and ensure they are safely locked off.
- Check the trailer load is secure and that tyres are in good condition and correctly inflated.
- Remove any chocks or wedges from the wheels.
- Release the trailer handbrake.
- Check the number plate corresponds to the towing vehicle.
- Check all lights function correctly.

3.2.3 **Notes**

- The weight of the laden trailer should be within that recommended by the towing vehicle manufacturer, as should the nose weight.
- Make sure that the trailer you are about to tow off is the one you're meant to be towing!
- It is important to match the height of the hitch to the trailer. If it is set incorrectly it will drastically affect the departure and attack angles you can manage – a serious problem on rough ground. (Departure and attack angles refer to the maximum angle between the trailer and its towing unit either entering or leaving a slope.) If you do adjust the hitch height then stop after 15 mins/5 miles or so and check all nuts/bolts/pins etc.
- It is far easier to check your height and width before you set off than to do so at the low bridge you encounter on the twisting country lane.
- It is WRG procedure for the spare (trailer) number plate to be kept with the vehicle to which it corresponds (usually in the glove box).
- Check the lamps on the trailer and the vehicle are of the same voltage – the type of plug and socket should tell you.
- The electrical cable should be clear of the ground, but please leave enough slack to enable the rig to go around corners.

- Be aware that the towball height of a vehicle changes depending upon internal load. You may need a decent block of wood under the jockey wheel/front leg to increase the parked height.
- Another point is always check the load before you go out – you'd be surprised how many people leave mugs, tools etc. on mudguards.

3.3 Disconnecting

3.3.1 Safety

- Ensure the parking brake of the towing vehicle is applied.
- Keep your feet out from under the A-frame when disconnecting – it is not unknown for legs, jockey wheels, etc. to slip and delay your trip with a jaunt to the local Casualty Department.
- Be very careful to engage the trailer brake before disconnecting – on a slope the trailer may pin you to the vehicle or disappear into the distance.
- Do not use bricks, sandstone blocks or similar as chocks or supports for jockey wheels – they have a habit of pulverising.
- Always ensure that you are not blocking access especially for emergency vehicles.

3.3.2 Procedure

Employ the reverse of **CONNECTING UP**, however, please note the following additional points:

When dropping the leg/jockey wheel make sure that it has a couple of inches of thread used – the collecting vehicle may have a lower hitch than yours and leaving some thread available means that they can wind the trailer down further.

Notes

- If you need to manoeuvre a four wheel trailer then it is easier to do so if you wind down the jockey wheel so that the trailer rests on the rear pair of wheels and the jockey wheel, however, BEWARE the sloping effects on the trailer load and never overload the jockey wheel – it is not designed for speed.
- Make sure that when parked there is sufficient space to load or unload safely and you stand a reasonable chance of coupling up later. The reverse of this technique can be used to your advantage if you are trying to stop someone from making off with the contents.

3.4 Hitches

3.4.1 Safety

- Always ensure the hitch height is set correctly for both the vehicle and the trailer.
- Always ensure that the weight rating of the hitch (usually stamped on the hitch) is not exceeded by the combined weight of the trailer and the load. OR
- Always ensure that the weight rating of the trailer (usually stamped on a plate) is not exceeded by the weight of the load.

- Never attempt to mix pins and balls or couple a trailer to a vehicle with lengths of rope or chain.
- Ball hitches – never mix differently sized hitches and balls and always ensure that all moving parts of a hitch do actually move and return to their correct position when released.
- Pin hitches – also come in several sizes and should be free enough to articulate in all directions. Always ensure that locking clips/pins, etc. are put back with the relevant unit when disconnected. The connection is however a lot freer than a ball hitch and so they place much greater strain on the hitch mounting and chassis components. This is especially the case on site where the "bouncy, bouncy" effect is considerable.

3.4.2 **Procedure**

See section "connecting" and "disconnecting".

3.4.3 **Notes**

- A light trailer is defined as being less than 3500kg maximum laden weight. The maximum laden weight of an unbraked trailer is 750kg or 50% of the kerbside weight of the towing vehicle whichever is the lesser. A braking trailer more than 1500kg laden weight must have a device (known as a breakaway cable) to stop the trailer in the event of separation of the main couplings and a trailer below 1500kg must have a secondary coupling or may have a breakaway cable if it is a braking trailer.
- Check the ball size, a 2" ball and a 50mm ball appear to be compatible but are NOT and there is a serious risk of the two parting company at inconvenient moments, like going round a roundabout or down a hill. Usually the 50mm ball is flat topped with "50mm" stamped on it and 2" units are round topped. American units are usually 2".
- Regarding towing hitches fitted to vehicles it is best to fit a standard ball hitch. There are combination hitches (i.e. ball and pin) which mean you can shift stuff around site and on the road, however, as mentioned above, beware the effects of "bouncy, bouncy" on the vehicle chassis.

3.5 Loading

3.5.1 **Safety**

- Always ensure that the trailer is adequate to take the load. Consider not only weight and speed limits but also any projection over the edge of the trailer and the ground you will be moving over.
- Always ensure the trailer is adequately braked to stop it moving while loading.
- Ensure any loading legs are lowered and locked.
- Remove all loose winch handles when not actually using them.
- Check clearances between the trailer load and the vehicle when cornering.
- Note for participants in WRG Drive Authorisation scheme: if moving plant you will need Driver authorisation for that piece of machinery as well as vehicles and trailers.

3.5.2 **Procedure**

The load centre of gravity should be along the centre line of the trailer and just forward of the centre line of the wheels, so that there is a downward force on the vehicle towbar – known as the nose weight.

3.5.3 **Notes**

- The towing vehicle handbook should state the preferred value of nose weight, however, a good rule of thumb is 25-50kg i.e. does lifting the hitch feel like picking up a bag of cement.
- The centre of gravity should be as low as possible.
- Be very careful when loading heavy equipment onto a trailer. The downward force on the loading ramps can pivot the trailer front into the air, which lifts the back of the towing vehicle which is where most handbrakes work. Interesting if you try and be clever and park on a slope so that gravity can help you unload. Solve the problem with a baulk of timber under the back chassis member of the trailer. Of course if your trailer has rear legs and you remembered to put them down you can laugh till you collapse (Remember to raise them before driving off though).
- Nothing stops you winching the trailer under the load rather than the load onto the trailer.
- If using H-bars or ladder racks to carry a long load don't forget that the angle between the trailer and tractor will chance as you go into and over hills. If possible put the projecting load on the offside of the unit as there is slightly less chance of catching passing trees, road signs, etc. Also watch low bridges all the way through as your height can change with the angles of road surface.

3.6 Roping Down

3.6.1 **Safety**

- Frayed or damaged ropes should not be used.
- Ensure that ropes do not pass over sharp edges – use suitable packing such as wood or carpet squares.
- All ropes should be tight so that the load cannot even rock, it's the inertia of a moving load against a static rope that breaks the rope.
- When using chains only proper systems should be used, do not knot chains to tie off a load. Ensure there are no loose ends of rope that will get caught round wheels, etc. either going forwards or backwards.

3.6.2 **Procedure**

- The idea that each section of rope is tied at both ends so that any breakages only release that section and not the whole rope.
- See the end of these notes for simple drawings of the simple "marlin hitch" and the complex "waggoners hitch". This is the traditional hitch used by lorry drivers for sheeting down loads and with practice is very effective and a great way to impress others. It comes undone easily when released and adapts to the load as required (aka carters knot).

3.6.3 **Notes**

- A newer system is the ratchet strap, again keep it tight and protect the straps going over corners. Beware worn ratchets that slip with the load coming loose.

3.7 Towing

3.7.1 **Forward**

- Going forward is really simple – if the weight distribution, tyre pressures and hitch height are right then the trailer should follow you exactly and all you have to do is leave a bit more clearance round bends. Remember to brake sooner rather than at the last minute and watch your clearance (including height).
- The most important point to facilitate this is remember to use the mirrors – a lot. Make sure that your mirrors are correctly adjusted.
- Remember you are longer than normal when pulling out and in.
- With roundabouts, there is something to be said for staying near the outside edge, on the grounds that you can't see the offside of a long trailer.
- Be on the lookout for cyclists who creep past the trailer and then sit in the space between the towing vehicle and trailer.
- The key to easy towing is to maintain momentum wherever possible. Ease off the power and approach traffic lights slowly so that you don't actually stop before the lights turn green.
- Try not to park facing uphill – fine for showing off your hill start skills but unnecessary work for the vehicle.
- If the vehicle starts snaking the usual cause is bad weight distribution, normally not enough nose weight, but it can be left/right balance or incorrect tyre pressures. An easy answer to this may be nothing more than moving the spare wheel from back to front – whatever you do slow down until you have solved the problem. But remember don't brake sharply in order to slow down, just ease off the power till the trailer comes back under your control.
- On a narrow winding hilly road once back on the level or going down hill give some thought to letting any traffic that has built up behind you go past.
- Remember that your height may well be above the bottom of many projecting road signs, give them a wide berth.
- Punctures on most roads are dealt with as normal but it is recommended that the units are left coupled up. On a motorway with an offside puncture give serious thought to calling out a breakdown service. John Palmer suggests that if on an unknown route with a reasonable weight trailer and with little motorway work, an average speed of 20 mph is not far from the truth. Mick Beattie would say this is a little pessimistic but agrees that towing can drastically increase journey times.
- Think before parking, if the area fills up can you still get out? When you return to a parked unit have a good look at the connections to ensure they have not been tampered with.

- Use all your mirrors to keep an eye out for the load wandering. If you notice vehicles staying well back it may be a trailer fault, stop and check as soon as possible.
- When manoeuvring in tight spots then feel free to get out and have a look at what you're doing or, better still, have someone with you – preferably someone you have faith in and who uses the same signals as you.
- Turning through access gates or narrow entrances – you should be as close as possible to the other side of the road. Turn sharply so that the front corner of the vehicle just misses the gate post at the far end of your approach side, make no allowance for any extra width of the trailer, but keep turning so that you straighten up in the centre of the gateway. There is no shame in practising this with cones, etc. in a car park and indeed WRG trailer instructors insist on this when instructing new trailer drivers.
- Don't assume that if you got through once you will always get through. Site hazards and conditions may well have changed while you were out shopping!
- On the road you will rarely have problems but, if on site, make sure you can get out before merrily charging into the mud. A half mile reverse along a narrow towpath is good practice but not recommended with a working party being held up.

3.7.2 **Reversing**

- Start off by operating the reversing catch! This is not the joke it seems, it is the most common mistake when reversing and failure to do so leads to stuck brakes, burnt out clutches skids and dangerous uncontrolled manoeuvres. Many modern trailers have automatic hitches that do not engage the trailer brakes if the force is applied gently (such as when the vehicle slowly pushes the trailer backwards) but does engage the brakes when the force is applied quickly (such as when the vehicle brakes suddenly). With these hitches there is no manual catch to engage.
- Make sure that your mirrors are well adjusted and take it very easy. If possible have someone outside watching you, to avoid collisions with objects and especially the public who often seem oblivious to manouvering trailers. Trailer reversing is best summed up by the joke "If I was going over there then I wouldn't have started from here". Initial positioning of the trailer and vehicle is essential to achieve a really smooth, impressive "I could be in WRG Logistics you know" manoeuvre.
- To reverse in a straight line watch the mirrors and whichever way the trailer starts heading off in, move the top of the wheel gently that way. If it goes too far off square pull forward again until the whole lot is in line again.
- When preparing to reverse round something, just before you stop going forward turn so that the vehicle and trailer are slightly kinked in the direction you want to go. Then repeat the procedure of watching in the mirrors and turning the wheel towards the mirror with "too much trailer" in.
- Beware the act of jack-knifing the trailer – and never push the trailer round using the vehicle while jack-knifed. It can do serious damage and there is no point in turning the vehicle round in double quick time only to have to spend an hour rebuilding the electrics socket before you can set off. Remember to keep an eye on your front end when reversing as well as crumpled front wings are a common accident.

- Of course if you are lucky enough to have a front bumper hitch and a small trailer that you can see over the top of then life is much simpler and safer.
- Other tricks with small trailers are to place a road cone on top and use the internal mirror, if fitted. An alternative is to try laying a suitable length of wood across the load so that your mirrors have something to see. Don't forget to remove these items when you go out on the open road.
- Now release the reversing catch (if appropriate).

3.8 Electrics

3.8.1 The lights at the back end of the unit should follow (i.e. match) the lights at the back end of the towing vehicle. The only exception to this is the vehicle rear fog lights which may be extinguished leaving the trailer only on to avoid glare when reversing, etc. This is usually done with a switch on the socket. If fitting the sockets try not to put them at the same height as the hitch, because the first time you manoeuvre into a decent angle you will demolish the plug and socket. Not so bad on a new installation when everything still comes apart easily but if subject to several months road grot! It really is worth fitting the sockets out of harms way and putting a slightly longer plug cable on.

3.8.2 There are three wiring standards generally referred to for connecting vehicle and trailer electrics. And life is difficult in that neither plug or socket is a true plug or socket both having a combination of male and female components. However, the normal convention is that the connector with the majority of male components is the plug and the connector with the majority of female components is the socket.

3.8.3 The system is further sub-divided into 12N (normal) and 12S (supplementary). The 12N should have a black spring-loaded cover and the 12S a white spring loaded cover.

3.8.4 The older standard using the 12N plug was in the days before rear fog lights and used one pin for caravan interior lights. When rear fog lights became standard the industry did something very sensible, for a change, and said that the new standard will use this pin as rear fog lights following this with the third standard the 12S for interior lights, fridges and other caravan type things.

3.8.5 Of course you can use any type of connection you like – even a chocolate block but all WRG trailers use the 12N standard as recommended by all statutory bodies, which is:

12N pin	Cable Colour	Service
1 (L)	Yellow	Left indicator
2 (54G)	Blue	Rear Fog
3 (31)	White	Earth
4 (R)	Green	Right indicator
5 (58R)	Brown	Right tail lights
6 (54)	Red	Brake
7 (58L)	Black	Left tail lights

3.8.6 Note that the white cable should be thicker than the others since it is the 'earth' and takes all the electrical load. Don't economise with bodgy bits of cable, the proper 7-core cable is available from good auto electrical shops (such as Lucas) and is not expensive so there is no excuse for not using it.

3.8.7 When checking the lights remember that indicator and brake lights normally only work with the services on. Test all the lights individually and then all together to check the connections can support the maximum electrical load.

3.8.8 In the event of a fault that gives the wrong light or the others flashing start by checking the earth both on the trailer and the vehicle.

3.8.9 There should be either a warning light on the dashboard or an audible buzzer to show that the trailer indicator lamps are functioning correctly, fine provided that the buzzer is not obliterated by the load or a very loud radio.

3.8.10 An easy way to provide some protection for the plug end of the cable is to find a short length of plastic pipe (to suit the trailer colour scheme – yellow gas or blue water) and slip about 1ft (300mm) of it onto the cable. Make sure this is on the loop that can hit the road and it will take a surprising amount of road wear and saves the cable from needing replacement so regularly.

3.8.11 When making up a new trailer cable, once you have cut your cable to length examine both ends. One will have the cores in the same order as the pins of the plug, the other will be in reverse order. It's much easier to use the first end than to have to twist each core across all the others to get to the right pin.

3.9 Tyres

3.9.1 Tyres are a traditional area for economy with trailer designers. This is not good news as it means they are often so small as to ruin your ground clearance across site and they are also more susceptible to damage and are not suited to fast/long haul journeys. Do not economise on tyres, they should be as good as the towing vehicles and damage to tyres and wheels should be considered just as disastrous as damage to the towing vehicle. Tyre pressures should be marked on the trailer and adhered to.

3.10 Security

3.10.1 Always be wary of people trying to steal your trailer. If you leave the trailer unattended at any time then fit all the security devices (usually the wheelclamp and hitch lock) but remember to remove them before you set off. This applies whether the towing vehicle is attached or not. A common place for trailers to go missing is motorway service stations when the driver stops just to go to the toilet. Remember that the trailer represents a sizeable effort from WRG Logistics (or whoever) in itself and the contents will take months and many thousands of pounds to replace.

3.10.2 The practice of leaving the trailers wedged somewhere that is very difficult to get them out from is fine but please remember someone else has to get the thing out.

3.11 Law

3.11.1 This is a minefield and is not only constantly changing but also a source of rumour, hearsay, and misinformation. A good start is a reputable trailer dealer or a real auto electrical shop for the latest interpretations of the regulations.

3.11.2 However, some definite facts are:

- On a motorway with three or more lanes you are not allowed in the lane closest to the central reservation
- When parked at night you must not only park on the nearside, unless on a one way street, but you should have your lights on
- All three number plates should show the same sequence of digits, and be in the same style (but may be a different shape)
- Unless the towing vehicle has a side door for the rear passengers the maximum number of people allowed is eight when towing
- Any projections at the back must be marked and if over 3' 6" (1.06m) must carry the correct triangle and be lit at night

3.11.3 The position of lights is a minefield: John Palmer's answer is to put lots of them everywhere which, so far, has kept the authorities away. However, it also blows the fuses in the van so the correct answer is to go and see your local Auto dealer (such as Lucas Autoelectrics) who will, at the very least, have a wallchart to explain the latest version of the regulations. Ask him nicely and he may give you a free copy.

3.11.4 Further information is available from Indespension (a very reputable trailer manufacturer/ distributor). They do an excellent trailer manual full of such information for £2.

APPENDIX 1 –
VAN INFO SHEET/LOGISTICS CHECK LIST

VEHICLE REGISTRATION:	R10 RFB	Only drive if:
LENGTH:	5.55m (18'3:)	1. Completely sober and not under the influence of drugs or medicine
WIDTH (exc. mirrors):	1.98m (6'6")	2. You are not too tired or sleepy
HEIGHT:	2.44m (8'0")	3. Authorised by site leader
MAX. NO. OF PASSENGERS:	5 (exc. driver)	4. Carrying valid WRG authorisation card
		In the Event of an Accident
USE DERV DIESEL FUEL ONLY. **FILLER CAP BY FRONT PASSENGER DOOR**		1. Give your and the vehicle owners name and address and the registration number of the vehicle 2. Produce driving licence to police 2. Inform them that vehicle documents are held centrally and will be presented at **Rickmansworth Police Station** 3. Inform WRG Head Office as soon as possible 4. If vehicle can be safely driven you may continue to your destination but then your authorisation to drive WRG vehicles on the highway is suspended until further notice.

Vehicle owned by:	Waterway Recovery Group Ltd., 3 Norfolk Court, Rickmansworth, WD3 1LT 01923 711114
Vehicle insured by:	Cornhill Insurance Plc

Waterway Recovery Group Logistics Van Checklist

Camp No:	
Location:	

Van present from:	To:	
Mileage at start:	Finish:	
Maintenance	Oil added:	
	Water added:	

Van condition:	
Tyres tread/side wall	Front nearside:
	Front offside
	Rear Nearside:
	Rear offside:
	Spare:

Van condition:	Interior
	Exterior
Faulty lights:	
Damage to Van:	

Camp leaders signature:

List all drivers of the van on the reverse of this form and return to WRG Logistics

APPENDIX 2 – ITEMS SPECIFIC TO WRG VEHICLES

As mentioned already, if in doubt about roadworthiness, do not drive a van or tow a trailer. That is what we pay a huge amount of money to a breakdown recovery agency. Remember to state if you have lots of passengers and/or a trailer when you ring them up.

WRG, not unnaturally, participates in the WRG Driver Authorisation scheme. This means you must either be an authorised operator for the vehicle (and trailer if appropriate) or under the supervision of a WRG authorised instructor. Full details of the WRG Driver Authorisation scheme are given in PRH "Health & Safety Section 2".

Any damage to a vehicle must be reported to the WRG transport manager or WRG head office as soon as possible.

There are spare sets of keys held by various people around the country – contact the WRG transport manager or WRG head office for details. The master keys are held at WRG head office.

APPENDIX 3 – HOW WRG ENDED UP WITH THEIR CURRENT VEHICLES

In 1996/7 WRG replaced its van fleet. The following discussion does not attempt to suggest that one model or manufacturer is superior to any other but just to show the thoughts and considerations that went into such a sizeable investment.

We needed to replace our old vans as they were getting a little unreliable and new regulations/political pressures meant we needed to consider passenger seating and seatbelts. We needed a decent van that is easy to drive for everyone, can survive basic site conditions, can be fixed easily, has enough power for towing, won't depreciate too quickly, is economical and won't have the volunteers immediately condemning it as "a shed on wheels".

We test drove the models available and came up with:

DAF was old, under-powered, thirsty and struggling but it did have twin rear wheels and maintenance costs were low.

Fiat/Peugot is good, drives well but is low slung, therefore bad ground clearance and departure angle. It is also a little "European" under the bonnet.

Citroen/Renault looked really awful, was rumoured to be under-powered and was widely regarded not a serious option.

Mercedes Sprinter was brand new at the time so it was an unknown quantity. It was well designed apart from a few annoying points. We did know though that the turbo version was far too powerful. Normal version was very nice but expensive.

Ford Transits are well known by everyone and have reasonable reputation as the industry standard. Lots of Ford dealers around the country.

So we settled on Transits.

We also considered the possible sources: new purchase, ex-demo, used, lease and possible engines. Diesel was immediately chosen. We were in no hurry so we decided to wait for a bargain from whatever source.

We wanted to be able to transport people and materials/kit. The passengers must have seat belts. We decided to try a panel van and minibus for each Canal Camps circuit. Decision as to whether to convert a panel van to a minibus ourselves, get one converted by a third party or to buy a minibus straight away. We don't want the full minibus trim as it will only get dirty. Decide to get panel vans converted professionally – then by fluke we find two already converted to a basic level of trim. Buy those and a panel van.

We found a panel van (with only three seats) was a little limiting – decide to get fourth van made up as a utility vehicle (six seats and a bulkhead halfway down the vehicle to carry loads as well). It seems to be good solution.

That was a few years ago. If you want to know how it turned out stop any WRG van and ask the driver!

APPENDIX 4 – KNOTS AND HITCHES

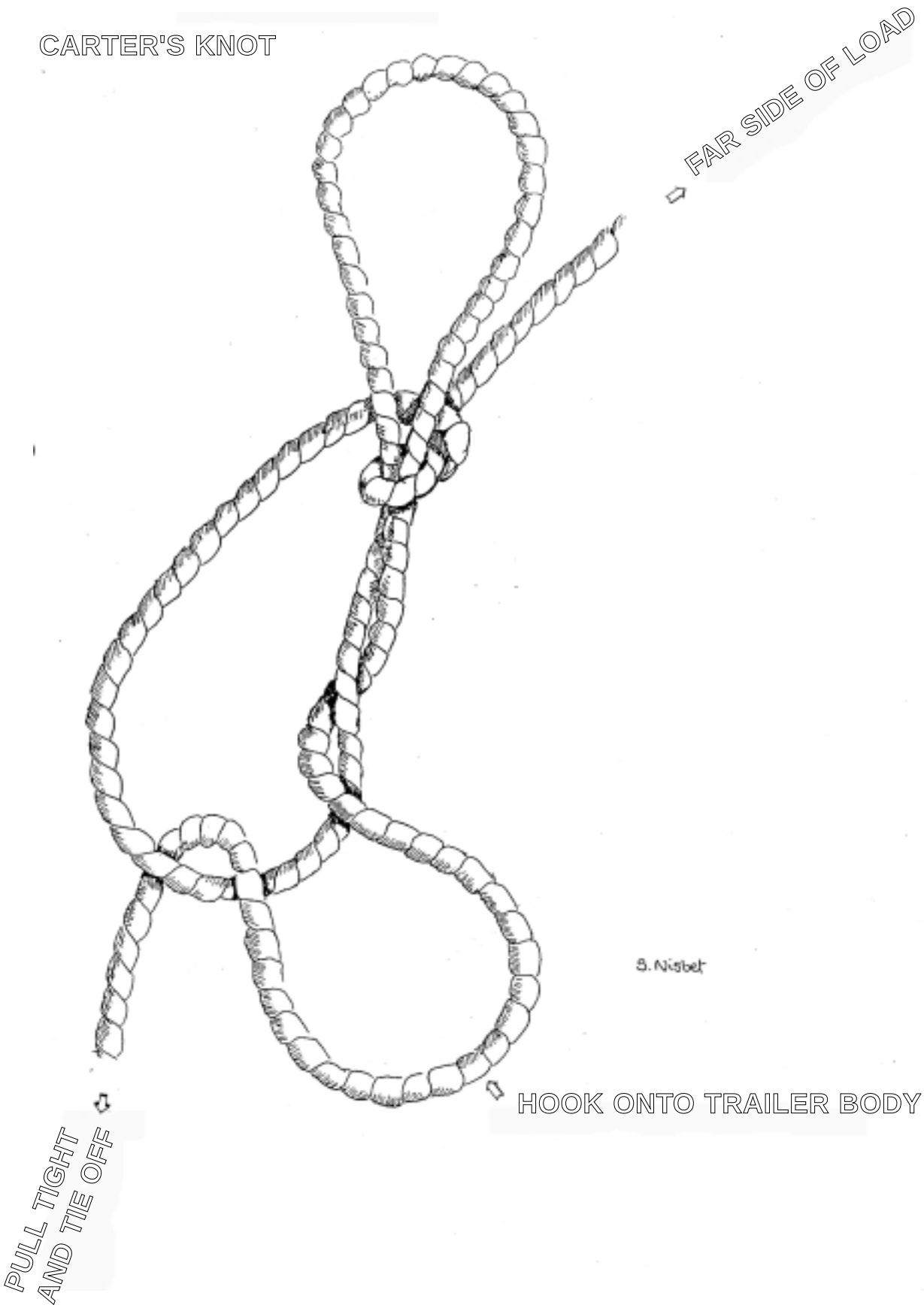
Drawings by Sandra Nisbet

CARTER'S KNOT

STAGE 1

STAGE 2

FAR SIDE OF LOAD



APPENDIX 5 – ADDRESSES

Royal Society for the Prevention of Accidents
RoSPA House
Edgbaston Park
353 Bristol Road
Birmingham
B5 7ST
0121 248 2000
www.rospa.co.uk

Neil Ritchie
Contract Sign Services
The Chapel House
Sandford Road
Churchdown
Gloucester
GL3 2HD
01452 854057

Atlantechs Ltd
Seat Covers
Royal Ordnance Depot
Weedon
Northants
NN7 4PS
01327 342484

Indespension Trailers
Ring 0121 561 5467 for your nearest branch

Practical Restoration Handbook

Hand Tools - Use, Care and Maintenance

by

Eddie Jones,
Kent & East Sussex Canal Restoration
Group Weekend Organizer

CONTENTS

INTRODUCTION

1. Hand tools are the most common and frequently neglected items of kit we come into contact with while on site. If used improperly or when damaged progress will be hampered and injury is likely to occur.

2. This document covers the range of tools available, the specific types most useful while carrying out restoration work, what to purchase, use of and maintenance/storage of hand tools.

3. Whenever working on site, adequate safety clothing must be worn. Stout boots with steel toe caps and a hard hat less than 3 years old are the minimum, with extra items suggested in relation to more specific situations.

DIGGING AND LOADING - SPADES AND SHOVELS

4. There is a wide variety of spades and shovels available. Their size, shape and name is dependent on what county or even what country you are in. The few types required for general work are detailed below, along with the more specialist ones and their application.

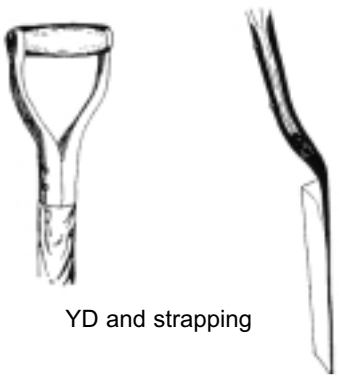
Handles

5. Before we look at the working end of a spade the users end must first be considered. There are two common types of handle on wooden shafted spades, the Crutch (or "T") and the "YD" type. The YD type is more comfortable to hold than the "T" type, and a capped "YD" handle is stronger than the capped metal type. Please see the diagram below.

6. There are two ways of attaching the handle to the blade, using either the socket or strapped method. Of the two, the strapped method is stronger as the handle retains its full diameter to the end, hence no weak points where it could break.

7. The handle and the fasteners should be smooth so the hand can slide unimpeded along the shaft when the tool is in use. The blade should be securely attached to the handle, if loose it is likely your hand will get trapped.

8. It is possible to obtain spades made entirely from metal which makes breaking the shaft very unlikely but once damaged the whole tool is a write off. The handles are also very cold on the hands. Deluxe versions are available with plastic coated shafts which are more comfortable to use. The drawback of this style is that the plastic tends to get damaged down the back of the shaft. This eventually produces a very rough surface which requires the plastic to be removed.



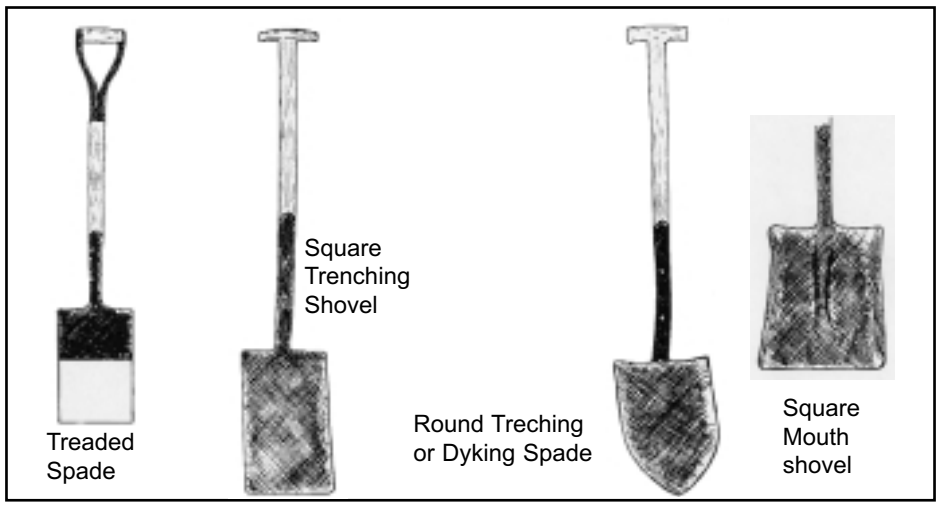
YD and strapping

Blades

9. The most useful general purpose digging tool is the **Treaded Spade**. The treads on top of the blade make it more comfortable to drive into hard ground than the Contractors or plain Garden Spade.

10. For shifting loose soil or gravel and for ditching work the **Square Trenching Shovel** should be used, which is really a halfway house between a spade and a shovel. For rubble and hard packed gravel the **Round Trenching or Dyking Spade** should be used, as it requires less effort to drive into coarse material than a square blade.

11. The final type of general blade is the **Square Mouth Shovel,** which is used to shift large quantities of sand, very loose gravel or earth, silt etc.



12. It is considerably easier to dig clay or wet, clinging soil with a blade made of stainless steel instead of plain steel as the spoil does not stick to the blade. Unfortunately, tools with stainless blades are approximately twice the price of normal ones.

13. For digging drains, post holes or narrow trenches then the **Newcastle Pattern Draining tool** should be used, the "wings" particular to the Newcastle style results in less strain on the foot.

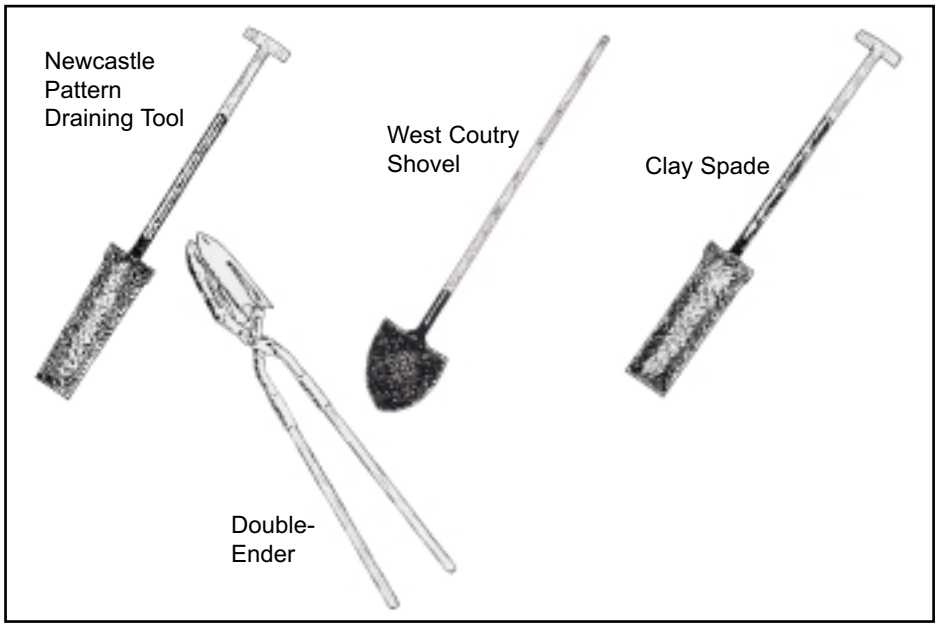
14. The combination/post spade, shoveholer or "**Double - Ender**^{TM}" tool makes digging post holes quicker than with a normal spade. The hole should be started with a digging spade and then a Newcastle Pattern used to break up the material in the hole. The shoveholer is used to remove the spoil, but not to dig. If many holes have to be dug it is well worth obtaining one, but bear in mind how long and cumbersome these tools are when it comes to storing and transporting them.

15. Although less common the **Irish** and **West Country Shovels** should be considered. With characteristic "long knob handles" they save bending while using them. This makes them easier on the back than other types of spade, but limits the amount of material that can be moved per lift because the long handle exerts greater strain on your back. For digging the long and pointed Irish blade is more suitable than the West country's shorter and wider shovel like blade.

16. When digging clay a **Clay spade** should be used. This has a narrow treaded blade similar to the Newcastle Draining type but with a parallel instead of tapered side to the blade. In use the tool produces a round plug of clay.

Technique for use

17. Stout boots should be worn especially when digging in hard ground. There are boots available with striking plates built into the soles to protect the feet, a very worthwhile consideration if a lot of digging is to be done by hand.



18. To dig with a spade, stand up straight holding the handle with both hands. Using whichever foot suits you, place it on the tread and push the blade into the ground. Cut the soil into square lumps which are as large as possible but still comfortable to move (trial and error). Hold the spade with one hand on the handle and the other halfway down the shaft. Placing the blade behind the lump you have cut, lever and then lift it clear it to wherever the spoil is being deposited.

19. Shovels should be held by the handle with the other hand halfway along the shaft. It is very important a proper stance is used while shovelling, or backache and even injury can result. Ensure you have a sound footing, for example if working on a bank cut a small step for each foot. When loading the shovel do not fill it beyond your ability to lift and control it comfortably. You should position yourself such that the minimum amount of twisting is done while moving the spoil. Turning while holding a heavy load on the end of a shovel is not good for your back. A slip while holding a loaded shovel can easily lead to a sprain and as we often work in wet, slippery conditions be sure of your footing at all times.

20. It is often easier to work as a team, one person breaking the material up while the other shovels it away.

Maintenance

21. Waterway Recovery Group and Kent & East Sussex Canal Restoration Group Logistics keep their tools painted to protect and identify them. However an occasional wipe with some linseed oil will help preserve them especially if they are to be stored for a long time. If the handles are painted they should be regularly inspected as paint can hide splinters, splits etc. Splinters should be sanded out but if a split is found the handle should be replaced. The blade should be free of burrs and straight. If damaged it should be ground but not to a razor sharp edge. If the blade has been bent it should be hammered straight on a flat surface.

22. The blades should be cleaned immediately after use before being put away. This is imperative if the days work has involved any construction work with mortar or concrete.

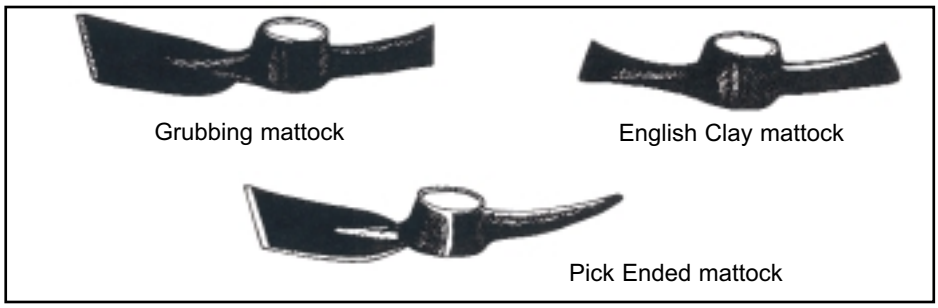
PICKS AND MATTOCKS

23. Although innocent looking tools, a pick or a mattock can inflict serious personal or third party injury. **It is imperative anyone using a pick or mattock is fully aware of how to use the tool and the potential dangers to both themselves and those around them!**

24. Picks and Mattocks are constructed in a similar fashion with a hickory shaft and a steel head. The type of steel used and the shape of the head distinguishes between the two.

25. Picks have a hardened steel head that gives them the strength to withstand being used to break up hard and stony ground. They can also be used to lever rocks out of the ground (but should not be used as wrecking bars!).

26. Mattock heads are made of much softer steel than a pick head, and so will burr if used on hard ground and bend if used to lever things. The **Grubbing mattock** has a wide flat blade which is used to break up soft ground, while the cutting end is used to cut tree roots. The **English Clay mattock** has a cutting blade at either end, and being slightly longer than the grubbing mattock is very useful for cutting roots when digging out stumps. The **Pick Ended mattock** is purely a digging tool, the lack of cutting edge makes it of little use when working with roots.



Technique for use

27. The art to using a mattock as with any tool you lift is to let gravity do the work for you. Hold the tool with one hand at the end of the shaft and your other hand near the tool head. If using a pick or the cutting end of a mattock lift the tool over your shoulder until the hand at the head end of the shaft is alongside your own head. Bring the tool down in front of you by simply guiding it and letting it fall under gravity. As the tool descends slide your far hand nearest the head along the shaft back towards your other hand. As the tool nears the floor you should bend over with it. **Do not** use your own weight or strength while bringing the tool down, as you will only prematurely tire yourself and possibly damage the tool itself.

28. With practice it becomes possible to place where the blade lands very accurately, especially useful when cutting roots.

29. The flat end of a grubbing mattock is not as strong as a pick or the cutting end of a mattock, and if swung from head height will be damaged. It should instead be used with half swings, holding the shaft with one hand at the end and the other halfway along. This technique should also be used with picks and cutting mattocks if the ground is very stony or a root particularly hard otherwise the tool could bounce back and hit you. If a large lump of stone is encountered it should be dug round to loosen it, and then prized out with a bar instead of trying to smash it with a pick.

Safety

30. Always wear proper safety boots with steel toe caps and good tread. Clothing should be un-restrictive but not so baggy it could get caught. A hard hat should be worn with the headband properly adjusted so it does not fall off when you bend forward. If breaking up masonry of any kind goggles or safety glasses should be worn to protect your eyes from flying splinters.

31. Do not carry the tools over your shoulder but alongside horizontally at the balance point.

32. Before using the tool check the shaft is free of splinters, cracks and is generally in good condition. Check you have the right head for the shaft and that the head is securely on the shaft - see the maintenance of picks and mattocks.

33. The shaft should be clean and dry. It is advisable not to wear gloves, but if soft hands make it a necessity only wear one on the hand that slides along the shaft. The other hand needs to have a firm grip on the end of the shaft to ensure the tool is not inadvertently let go while being swung.

34. Before wildly swinging a pick into the ground check there isn't anything solid just below the surface. Use the half swing technique initially or explore the surface with a bar.

35. If it is either raining or very slippery underfoot do not swing the tool from shoulder height, but again use the half swing technique. Ensure you have a sound footing and do not ever work downhill as it is very easy to lose your balance. Check there are no low branches or other obstructions immediately above you.

36. While working always be aware of who and what is behind you, and ensure everyone round you is aware you are swinging a pick/mattock or are about to do so. Always allow 3 metres between yourself and anyone else in the same area. If working with someone shovelling make sure you let them know only to approach when **you** have given them the signal, and are resting with the tool on the ground. At all other times ensure they keep a few metres back.

37. Never underestimate how stupid the general public can be. Be extra vigilant if working on a towpath and stop if you see anyone approaching. Rest until they have passed before resuming work

Maintenance

38. The heads should be left on the shafts at all times. The one exception to this rule applies to tools made along the army design fitted with a "**Grip-fast**" on the shaft. This is a metal sleeve which means the shaft is protected from damage caused by the head cutting into it.

39. The end of the shaft should sit just proud of the head, not below the edge of the hole or very proud (the sign of a head/shaft mismatch). If you find the head becomes loose while on site try placing the tool with the head under water for 20 minutes. This will make the shaft swell and tighten the head up. Any splinters found on the shaft should be sanded. If a split is found the shaft should be replaced.

40. The cutting end of a grubbing mattock and those of a clay mattock should be kept sharp. The flat blade of a grubbing mattock should be kept clear of burrs and any severe dents/chips ground out. It should not however be sharpened like a cutting edge. It is important picks and cutting mattocks are kept cool while grinding by regularly placing it in water. If the steel is over heated it will lose it's temper and become soft.

STRIKING AND LEVERING

41. For general demolition/construction works a **sledge hammer** is the most useful. For long periods of use a 4.5Kg (10lb) head is comfortable but for stronger people or more demanding jobs sledges with a 6.3Kg (14lb) and even bigger heads are available. A sledge hammer should not be used on wood, i.e. driving in posts because it will split them.

42. To use a sledge follow the instructions for a pick or cutting mattock, but bear in mind it is considerably heavier and is quite capable of breaking a shin should you slip! It is imperative you do not use a sledge heavier than you can manage, not only could you injure your back but you would lack control which could endanger both yourself and others working round you.

43. As with mattocks the sledge shaft should be inspected before use and discarded if split (sledges are prone to shaft damage just before the head). Replacing a shaft is a skilled job. The shaft must be carefully sanded until the head just fits. Once the head is on the shaft with the end flush with the shaft hole, suitably large wedges must be driven in to expand the end of the shaft and hold the head in place.

44. **Lump** or **club hammers** come in a range of sizes upto 3.2Kg (7lb) but are fitted with very short handles as opposed to the long shaft of a sledge. 1-2kg (2-4½lb) are most comfortable for extended periods of use.

45. **Scutch** hammers are very useful when cleaning bricks to chip off the old mortar. The flat blade at the end of the head can be replaced if necessary.

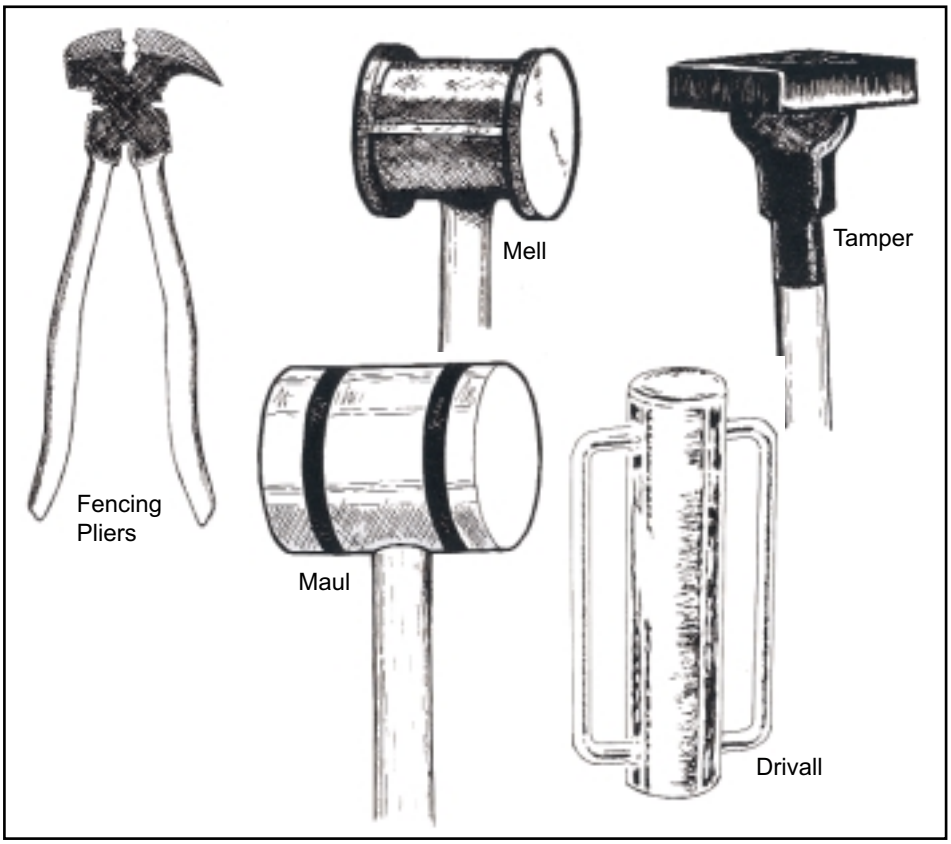
46. When fencing a **fencing hammer** or **fencing pliers** should be used. This combination tool has a set of cutters for wire, grips to pull on wire, hammer to drive in staples and spike to lever staples out. A **claw hammer** is a very useful tool when carrying out woodwork jobs. Again available in a range of sizes and typically with synthetic maintenance free shafts.

47. A **Mell** or **Maul** hammer is used to drive **wooden** posts in. A mell is made of cast iron or aluminium with large flared ends. Because they are cast they will shatter if used to strike anything hard. A maul is a very large wooden hammer. With a greater diameter than a mell it is less likely to split a post but being lighter needs to be lifted higher. It is important posts are hit squarely with an experienced assistant holding the post vertical otherwise the post will split. If driving in a tall post find something stable to stand on so you are level with the top.

48. Rubber malls exist but are not suitable for driving in posts as they have a tendency of bouncing away. They are used to position flags when laying an area with flag stones.

49. A **Drivall**™ or “post bonker” is less tiring and safer to use than post hammers. The larger ones are best used between two people. The Drivall should be lifted over the post, raised slightly and dropped. Let gravity do the work for you to save your strength and so not to break the top off the Drivall. It is very important the Drivall is not lifted too high because it can catch the post and jam, or even come off the post completely. This results in you pulling it towards your head. If the post is being driven in close to ground level do not bend over but work on one knee as it gets lower.

50. A **Tamper** is very useful when posting to firm the soil around a post when placing in the ground, and for compacting gravel on towpaths. On site an upturned post or suitable branch can be used if a tamper is not available.



51. **Crowbars** and **Wrecking Bars** are available in various lengths with either a straight or swan neck. They are used to move or position heavy objects such as coping stones, breaking up old masonry or brickwork, start post holes etc. Wrecking bars have a chisel at one end and a point on the other. The length and diameter depends on application and strength, but a 1.5m (5') or 1.8m (6') by 3.2cm ($1\frac{1}{4}$") is most useful.

52. A crowbar or nailbar is shorter with a swan neck and is more manageable in confined spaces than a straight bar and can be used to remove nails.

53. Never carry a straight bar over your shoulder but vertically with the point near the ground. Straight bars are used to lever heavy objects, start holes for posts etc. They should not have scaffold poles slid over them to obtain more leverage or be used by more than one person as they will bend and be ruined.

54. When placing coping stones you will sometimes find a "V" cut into the top edge. This is so the stone can be levered into place without damaging the dressed edge.

55. Do not hammer a wrecking bar as this will ruin the hardened point. Should the end of a bar become damaged it will require grinding back to the correct shape. It is important the bar is kept cool while grinding by regularly placing it in water. If the steel is over heated the temper of the steel will be lost and then it will become soft.

FORKS, RAKES AND GRAPPLING HOOKS

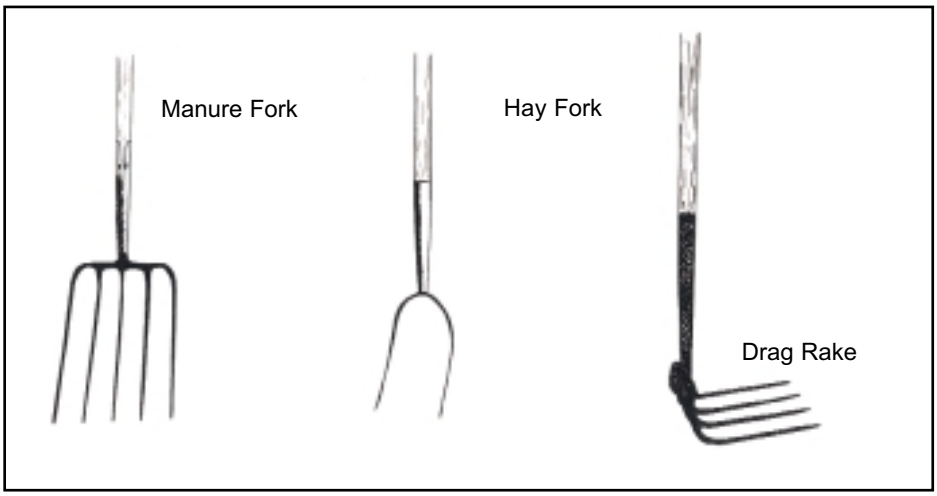
56. The **Digging Fork** is useful for loosening soil when digging. The "YD" style handle is preferable for comfort and preferably constructed with a strapped handle for strength.

57. When scrub clearing the four pronged **Manure Fork** is best for carrying vegetation, while the two pronged **Bale Fork** is ideal while tending a fire (the two pronged hay fork isn't as strong as a bale fork). Be careful not to overheat or burn the handle as this will weaken it.

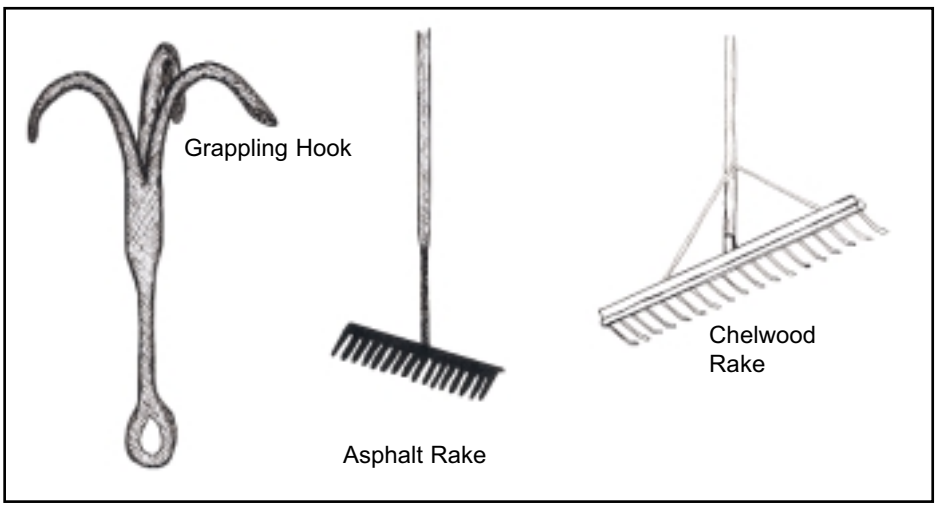
58. A **Manure Drag** or **Drag Rake** or **Keb** was originally invented to pull manure off an open backed cart and spread it over a field. It readily adapts to restoration duties pulling vegetation/rubbish out the cut, and is ideal when retrieving objects dropped into the cut/locks etc.

59. A **Grappling hook** with a length of rope attached is a most useful tool if felling across the cut for example and the cut is in water. Before throwing the hook ensure the other end of the rope is tied off and the rope is not tangled. With half the rope coiled with the hook, hold the rest of the rope in your other hand. Keep the palm of this hand flat so the rope can pay off as the hook travels away. Finally check there is no-one behind you as the hook is swung and most importantly there is no-one anywhere near where you intend the hook to land.

60. **Garden Rakes** or the more robust and wider **Asphalt Rake** are required when finishing towpath surfaces in gravel, and when landscaping. The **Chelwood Rake** has a flat "bulldozer" type blade on the reverse side of the head to the prongs which is used to move the material as it is spread out. Rakes do not have the strength required to lift material onto a fire and should not be used to do so. Wooden hay rakes do not have the strength for most jobs associated with restoration work.



61. Always leave rakes with the prongs in the ground when not in use. This will avoid the classic comedy scene where someone stands on the prongs and is hit in the face by the handle.



CUTTING

62. The most common type of saw used on site is the **Bow Saw**. They are made of spring steel and have a quick release blade retention system. They are available in a range of sizes as follows; 30cm (12”), 53cm (21”), 61cm (24”), 76cm (30”) and 91.5cm (36”).

63. The 30cm saw is a little small for tree work unless working in a very cramped situation, but it will accept 30cm hacksaw blades which saves carrying a separate hacksaw. The 53cm saw has a triangular shape which allows it to be used in confined spaces but with the ability to cut up to 13cm (5”) diameter. The 61cm saw is the smallest of the ‘D’ shaped types. It is the most universal, being comfortable to use and able to cut up to 23cm (9”) diameters. The 76cm saw is more suited to logging while the 91.5cm saw is best used by two people.

64. Bow saws can be fitted with two types of wood cutting blades, peg or raker tooth. Peg toothed blades (Sandvik type 51) are suited to dry or hard woods, i.e. thorn. They will jam if used to cut wet or green wood. The Raker toothed blade (Sandvik type 23) is designed specifically for cutting wet and green wood. It creates a far wider cut meaning the blade does not jam so easily. Bow saw blades cut in either direction, but hacksaw blades do not. They are marked with an arrow which should be fitted with the arrow pointing to the end of the saw. The blade cuts as you push the saw away from you.

65. The saw should be used with slow full length strokes as opposed to short rapid strokes concentrated on the centre of the blade. If using the 91.5cm saw between two people, they should be at either end pulling on alternate strokes. As blades wear out the teeth lose their set (the amount they are offset from the blade) and they stretch. This makes them very tiring to use as the blade will jam easily and makes it very difficult to cut in a straight line. A blade in this condition should be discarded.

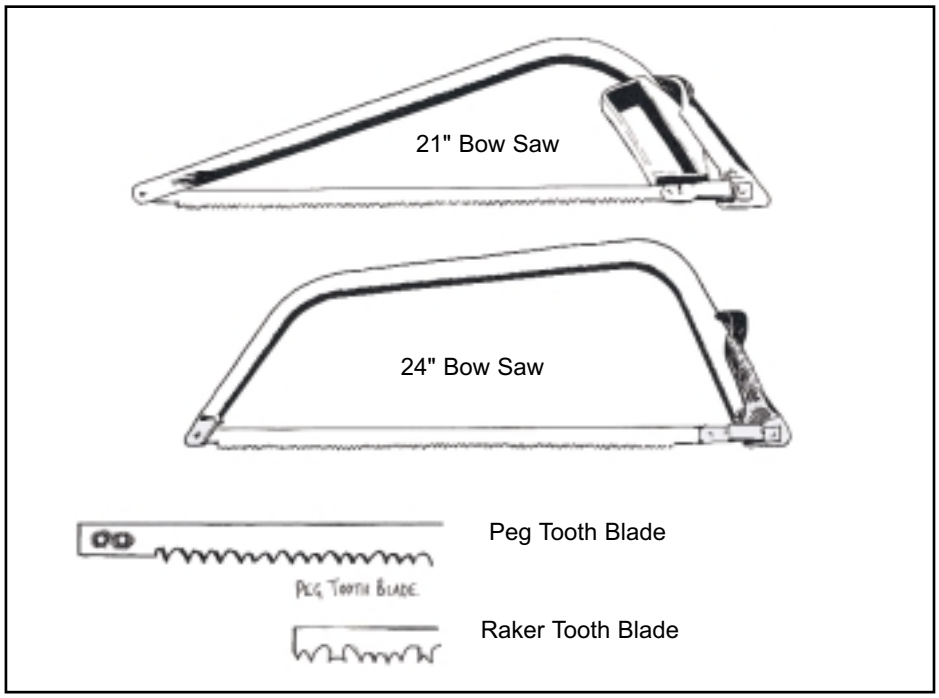
66. Used blades should not be left lying around but wrapped up and disposed of properly, preferably at a local council dump. To change a blade the saw should be held vertically with the blade against the ground. The handle should be folded down which allows the blade to be released from the handle. At the end of the saw the blade is fastened with a rivet which should be pushed through the frame to allow the blade to be removed. Fit the new blade into the end of the saw ensuring the rivet is located in both sides of the frame. Locate the blade into the handle and fold the handle back up until firmly against the frame. The handle can snap back and so should be taken with the saw held against the ground.

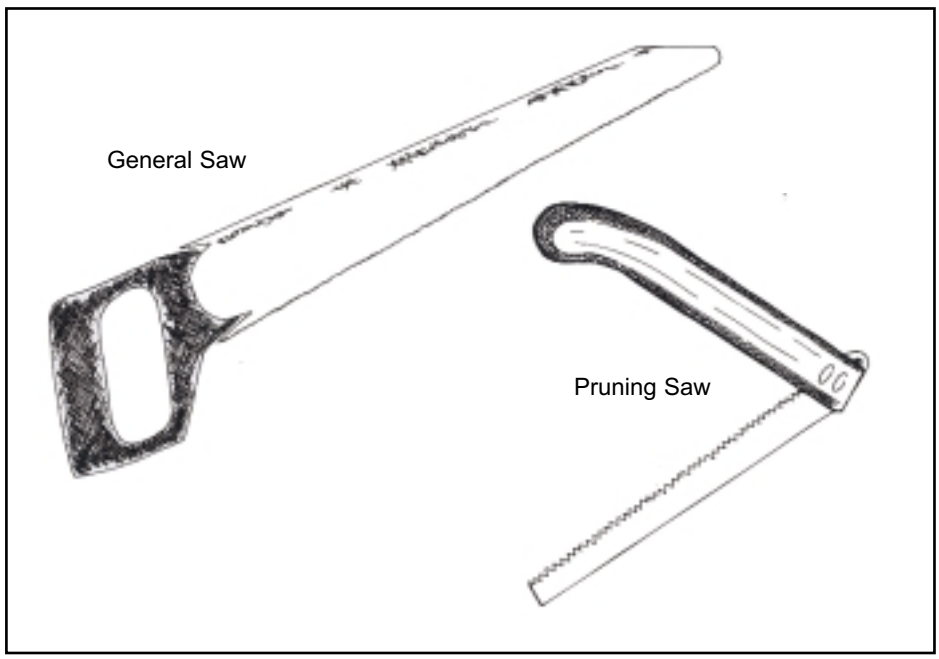
67. Saws come with protective covers when new which should be safeguarded while the saw is being used. They should be replaced when the saw is finished with as they prolong the life of the blade and make it considerably safer handling the saw. When walking with a bow saw it should be carried over the shoulder with the blade behind you.

68. **Pruning saws** are very useful when removing smaller branches from trees. They are available either as folding or fixed types designed to be attached to a pole. The folding type is useful when snedding trees (the removal of branches off trees that have been felled before they are logged). The fixed type are used when brashing trees (removing branches higher up on a tree to be left). Fixed types are available with a hook on the end of the blade to stop it slipping out of the cut. Both types only cut on the pull stroke (the blade is not rigid enough to allow cutting on the push cut).

69. The **General Purpose Saw** is a very useful addition to any tool kit. Although primarily a wood saw it can also cut metal and plastics. The handle can be adjusted relative to the blade making it ideal for awkward locations.

70. **Masonry saws** are available which can be used on softer stone. Their coarse teeth makes them very distinctive compared to other saws.





71. **Bill hooks** and **Slashers** are available in a variety of shapes. The **Southern Counties/Devon Billhook** is the most ideal for clearing and snedding work. It is light enough to be used with one hand without strain. The **Irish** is the best type of slasher for general work. The double edged types should be avoided as they are heavy, require practice to use and are very dangerous in unskilled hands.

72. Before using either tool check the handle for splinters or cracks. Splinters should be sanded out and if split the handle should be discarded. The blade should be firmly attached to the handle and it must be sharp!

Technique for use of a slasher

73. It is imperative anyone using a slasher is fully aware of how to use the tool and the potential dangers to both themselves and those around them!

74. For clearance of scrub the slasher should be held with one hand on the heel and the other halfway along the shaft. The slasher should be swung through a wide arc bringing the hand along the shaft to meet the one at the heel towards the end of the swing. The cutting relies on the momentum of the swing rather than energy from the user. Both hands should be kept on the shaft at all times, do not end the swing hanging on to the end of the shaft with one hand. This is dangerous as the tool is not under control.

75. Conserve energy by using regular swings as clearing is heavy work. If started swinging wildly you will quickly tire. This could lead to pulled muscles or injury through the slasher not being under control.

Safety

76. Gloves should not be worn when using a slasher as it reduces the grip on the handle. Goggles or safety glasses should be worn to protect your eyes from wood chips or thorns/branches. Ensure you are **AT LEAST** 5m (16') away from anyone working in the same area. Equally, do not work on your own in case you have an accident. Stop work if you begin to feel tired.

77. Do not use a slasher down hill, and do not work if it is raining heavily or is slippery underfoot. Slashers should be carried beside you at an angle with the blade pointing down in front of you.

78. It is very important the blade is kept sharp as it is tiring to use when blunt and can bounce off the wood rather than cutting it, potentially causing an injury.

Sharpening

79. On site the blade should be touched up regularly using either a **Cigar Stone** or preferably a **Canoe Stone**. The canoe stone is finer than a cigar stone which leaves a sharper edge to the blade required for cutting woody vegetation.

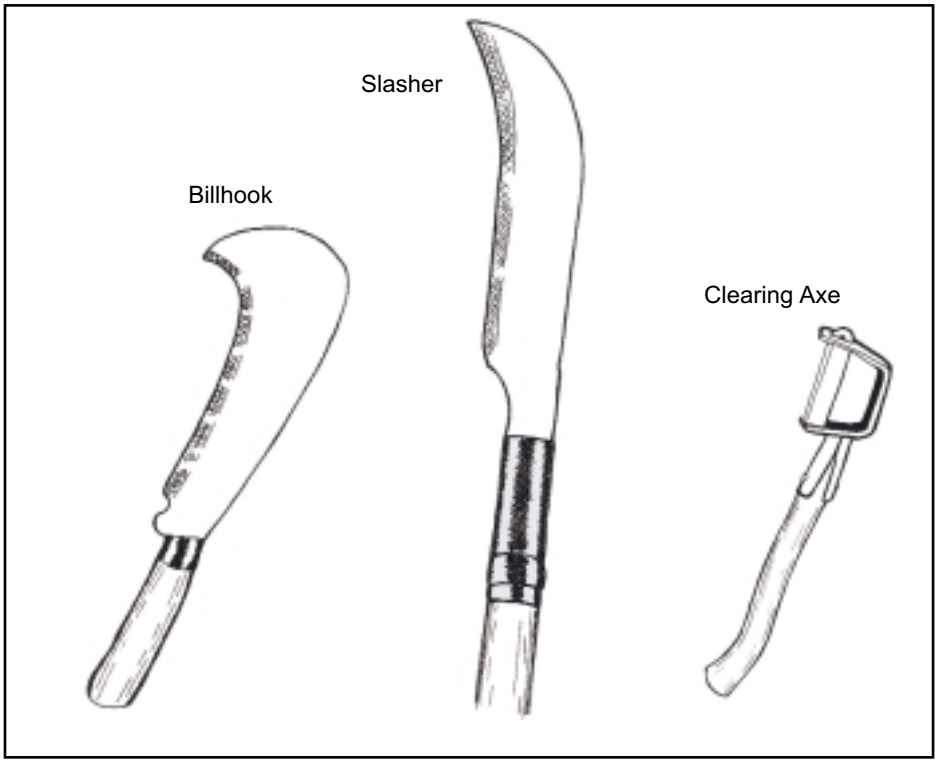
80. **Sharpening a blade requires concentration and skill**. If disturbed stop until your full concentration can again be applied.

81. To sharpen the blade you should kneel holding the slasher firmly with the blade downwards. One hand is used to hold the handle while the other holds the stone. Wear a glove on the hand holding the stone. The stone should be wetted, and then used to grind the edge of the blade in small circular movements. It is very important the stone is held at the same angle as when the blade was last sharpened. Once the length of the blade has been ground the slasher should be turned over and the exercise repeated. If the blade is ground with too sharp an angle it will quickly blunt, but if you try and grind the blade at too fine an angle you will find it impossible to sharpen with a stone.

82. If the blade is damaged it will need grinding on a bench mounted grinding machine. This should only be attempted if experienced with the use of such a power tool.

83. A **Clearing Axe** is designed purely for snedding trees. It has a replaceable blade and so does not require sharpening skills and is a lot safer to use than a billhook.

84. I suggest machettes are not kept in a common kit as they are dangerous tools. They need to be looked after and used with great care. They must be kept very sharp to be effective.



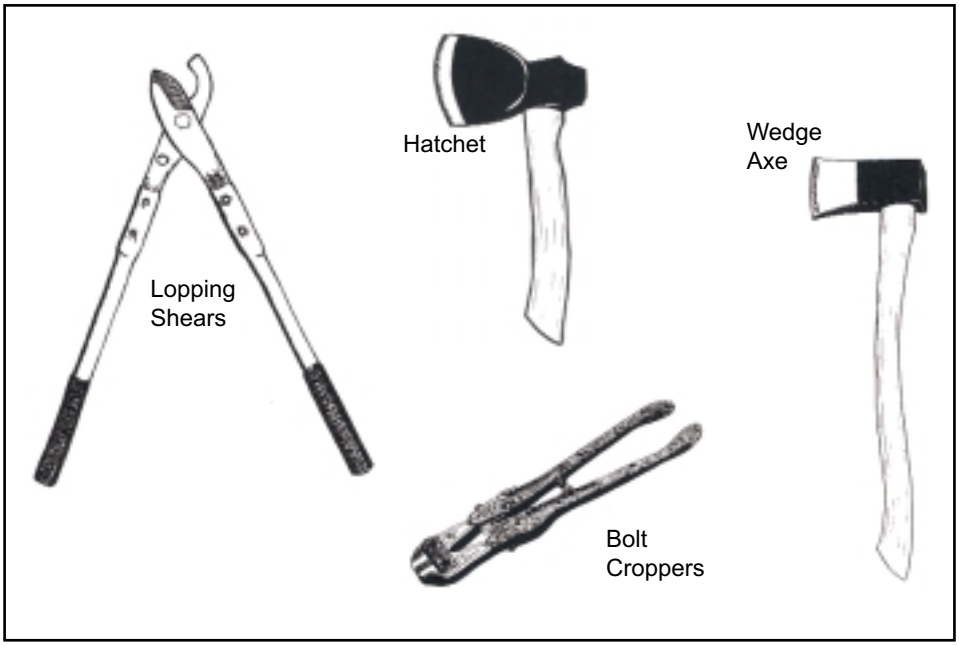
85. **Lopping Shears** can be used for cutting scrub and small branches up to 4cm (1"). They are available with either Bypass (Parrot nosed) or Anvil Blades. The bypass pattern is more effective on green wood. Loppers are often ruined by being used to cut material thicker than they were designed for. If they will not cut through the branch in one cut without a large amount of effort an alternative tool should be used, i.e. a bowsaw, billhook or clearing axe.

86. A **Hatchet** is a light one-handed axe with a wide body but narrow shouldered head. It can be used while snedding, hedging and for putting points on the end of fence posts for example. A **Wedge axe** is heavier and designed to cut soft woods. With a thick blade it forces the wood apart as it is cut and is useful for splitting logs. Axes are dangerous tools, great care must be taken while they are in use. It is strongly advised you do not use felling axes as they require great expertise to use - not only how to swing the axe but training in how to bring a tree down.

87. Axes should be inspected before use, any damage to the handle repaired if possible or the handle should be discarded. It is very important the axe head is firmly attached to the handle. The blade should be kept sharp, a special two sided axe stone with a rough and smooth side is available to sharpen axes. The advice for sharpening slashers should be followed using the rough side first if the edge has been damaged, finishing it off with the fine side.

88. When on construction sites **Bolt Croppers** are useful tools for cutting steel bar. They are available in a number of sizes and have replaceable jaws. They should be used by only one person at a time, and not subjected to excessive effort as they are designed to yield rather than break. The tool should not be rocked from side to side while being used to cut as the jaws will break.

89. Larger croppers have bolts around the pivot to adjust the gap between the jaws when fully shut. These will need to be adjusted periodically as the croppers wear with use, and set if new jaws are fitted. Once the adjustment bolts have been set do not forget to tighten the lock nuts.



WHEELBARROWS

90. There is a variety of wheelbarrow styles available. For restoration work I suggest the “contractors” type is used as opposed to the common garden type. The contractors barrow is stronger and, with the hopper further forward over the wheel, is easier to support when heavily laden. The long and shallow front to the hopper helps when tipping wet sand, concrete etc. as the load doesn’t stick. It is always worth carrying a foot pump and a puncture repair kit because pushing a barrow through mud, laden with a flat tyre is very hard work.

PACKING AND STORING

91. As mentioned in the text previously, tools should always be cleaned before being put away. If to be put away in damp conditions blades should be lightly smeared with oil to stop them rusting, and if wooden handles are not painted they should be given a wipe over with some linseed oil to help preserve them.

92. Ensure wherever your tools are to be stored is kept secure. Items like wrecking bars and sledge hammers are very useful for breaking into houses - worth bearing in mind if tools are to be kept in a garden shed for example.

93. Not only does painting the tools help protect them it also identifies them as each group has their own colour scheme. Please see the Appendix 1 for details of who uses what.

94. Waterway Recovery Group and the Kent & East Sussex Canal Restoration Group keep their tools in trailers. Although the trailers are very different to each other, they require careful packing to get all the tools in securely. If using either kit please make careful note of how they were loaded before anything is taken out. Each piece of tool or piece of equipment should be checked off against the kit list (the WRG kit is individually numbered) before being issued.

95. If any equipment is damaged while on site it should be marked with a note stating it should not be used, and put back in the trailer. A note explaining what has happened to it should be placed beside the entry for that particular item on the kit list.

96. Tools should not be transported in vans when carrying passengers unless in some kind of box, crate etc. which should be secured down.

ACKNOWLEDGEMENTS

Thanks to Dave Johnson for his technical advice and to Lou Kellet for drawing the diagrams.

REFERENCES

Caldwells tool catalogue

The Michael Richmond tools catalogue

APPENDIX 1 – HANDTOOLS COLOUR CODING

Base Colour only	
Red	WRG
Yellow	WRG North West
Light Blue	Huddersfield Canal Society
Split Base	
Red and White	WRG London
Red and Yellow	IWPS (Bugsworth Basin)
Red and Blue	WRG Camps Kit A
Red and Yellow	WRG Camps Kit B
Red and Purple	WRG Camps Kit C
Red and Black	WRG Camps Kit F
Red and Green	WRG Camps Kit R(eserve)
Red and Grey	WRG Camps Brick Kit 1
Red and Orange	WRG Camps Brick Kit 2
Red and Green	WRG Montgomery Project
Red and Silver	Chris Spencer
Stripes only	
2 Yellow sripes	Alan Jervis
2 Red stripes	Dave Wedd
1 Blue and 1 Yellow	Wilts and Berks CAG
1 Blue/1 White/1 Green	Chris Davey
1 Burgundy/1 Grey	Peter Smith
1 Light Green/1 Maroon	Wilts and Berks Canal Co
1 Light Green/1 Purple	Rachel Banyard
Base plus	
Green with fluorescent yellow band	KESCRG
White plus Black band	Hereford and Glos
White base, Yellow patch plus three Red stripes	John Palmer
White plus 1 Red 1 Blue stripe	WRG BITM
White plus Blue stripe	Luke Walker
Patch only	
Gold letters "Di"	Di Smurthwaite
Orange	Wey and Arun
Orange letters "SB"	Sue Burchett
Blue patch plus Yellow spot	Bob Dewey
Pink	WRG NE
Green patch/Purple patch	Alan Thorpe
Patch plus	
Yellow patch plus Black cross	Chelmsford IWA

Practical Restoration Handbook

Vegetation Clearance

by
Spencer Collins

CONTENTS

1. DEFINITION OF VEGETATION

1.1 Vegetation includes anything from grass to large trees, which has grown in the line of the cut and towpath and is required to be removed to reinstate the waterway. On a derelict canal, the size of the vegetation is dependent on how long the waterway has been idle. No trees above the size of saplings should be cut down with hand tools on grounds of safety. A rough guide to the diameter of a sapling is about the same size as your wrist i.e. 75mm. Any bigger than this and consideration should be given to it only being felled by a competent chainsaw operator who has passed the recognised safety courses.

2. PRELIMINARY PLANNING

2.1 The following areas must be looked into before starting work

- Conservation area consents
- SSSI's
- Listed Building consents
- Tree Preservation Orders
- Consider liaison with the Conservation Officers of the Local Authorities
- Will damage occur to canal structures if the vegetation is removed (i.e. winching a stump out of a wall)

3. NATURE CONSERVATION SURVEY

3.1 Before carrying out any vegetation clearance on a section of canal it is advisable to have an independent environmental survey carried out on the area concerned. This can show any sensitive areas where special care must be taken and additional information can be obtained e.g. working around badger sets, any poisonous or harmful plants and plants and trees to retain and protect. There is a wide range of consultants and Wildlife Trusts (Regional offices across the country) who carry out such surveys and these can be a valuable tool particularly if they find that the canal will benefit from full restoration, as they often do. Surveys are generally carried out in the spring with a follow up survey one year after the restoration has been completed. The cost of a survey is approximately £200 (dependent on the size of area concerned) for which grants can be obtained (see TRH "Funding Sources").

4. TIMING OF CLEARANCE

4.1 Vegetation clearance should only be carried out from August to early March to avoid disturbance to nesting birds and other wildlife. The working day is also limited to the short daylight hours of the season, which also avoids excessive disruption to any local residences.

5. GENERAL SAFETY AND SAFETY EQUIPMENT FOR VOLUNTEERS (non-power tools)

5.1 As with all sites a scrub clearance site should be treated as a building site with respect to safety. If the public have right of way through the site then warning signs should be placed at intervals before they get

to the working area (e.g. Tree felling, Brushcutters in Operation). The work site should be cordoned off with tape or fencing. If large trees are being felled then the public should be escorted through after ensuring the chainsaw operator is aware of their presence. A designated safety hat site should be established if there is any chance of a head injury occurring from falling material. This is particularly relevant in scrub clearance, as there is a strong likelihood of dead branches falling when trees are disturbed. If the site is a designated safety hat site all volunteers must wear a hardhat to BS 5240 Part1 1987 at all times. Goggles and ear defenders respectively should be available to the volunteers if there is any risk of eye injures (e.g. When chopping with an axe, hatchet or billhook) or noise (e.g. When working around motorised equipment i.e. raking up after a brushcutter). Some of the plants, weeds and fungi may well be poisonous and special care should be used in their removal (wearing rubberised gloves and washing hands, arms and face after it has been removed and before taking any tea/lunch breaks). These can be highlighted in the survey, take care of saps and berries. In addition there are however many common sense items which should be worn or available.

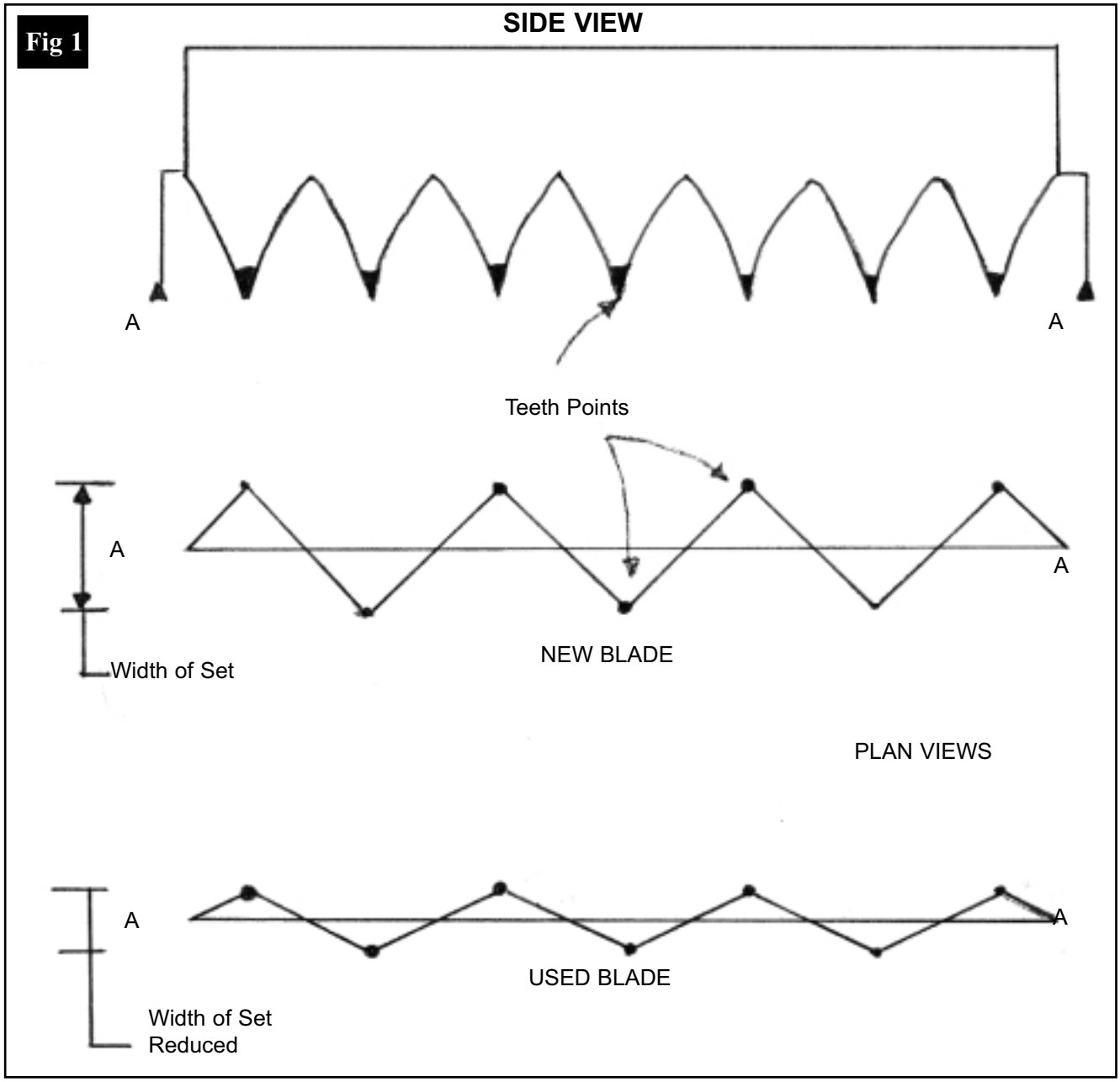
- A first aid kit must be available for use on site, first aid to HSE guidelines for number of people on site, there should be an appropriately qualified first-aider as part of the team.
- Gloves; A strong pair of gloves should be used. Welders' gauntlets offer good protection to the hands and wrists even when handling brambles.
- Steel toe cap boots / wellingtons. These should be worn because crush injuries to the toes and feet can easily occur particularly when stacking timber.
- Non snag outer clothing; Long trousers and long sleeve shirts are advisable in order to avoid cuts and scrapes to the arms and legs.

For further guidance see PRH "Health & Safety Sections 1-4".

6. HAND TOOLS

6.1 All tools should be in good order with no broken shafts, loose heads or missing parts. The operator should check this throughout the working day. Any defective tools should be taken out of service to avoid them being accidentally used. They should be labelled defective listing the reason why. Always make sure your tools are kept sharp, it will save time, effort and make the job safer. Always the correct tool for the job it was intended for.

- Bowsaws: come in many different sizes (30 cm, 54 cm, 60 cm and 75 cm), biggest is not necessarily the best as bigger blades tend to twist and stretch more easily than shorter sizes. The key to productive work is having a good blade. It is not the sharpness of the teeth that is lost first but the set of the teeth. Each tooth on the blade alternates slightly left or right of centre, and as the blade is used, this set is lost. The teeth become more in line with each other (see Fig 1). A tool is available to reset the teeth on a saw and this can be done very quickly on site. It is worth doing if dealing with large volumes of scrub as this increases the efficiency and reduces operator fatigue. Harden tip blades can not be sharpened once they are blunt they must be replaced. There are different types of blades available with different teeth patterns, number of teeth and size of teeth. The correct type of blade should be chosen depending on the material to be cut (dry Hardwoods such as Hawthorn require a 'Peg' toothed blade which has finer teeth. The course 'razor' tooth provides a faster cut on green softwoods such as Pine or Alder)



- Loppers: are used for pruning back branches to the trunk of trees. They leave a clean cut edge which is good if the tree is not going to be removed. There are many styles, which have various length handles , none of which should be used to cut through anything bigger than possible with a single cut.

- Slashers: there are many types of slasher available (e.g. axe back, Dunse, Irish). Slashers are intended for use on a vegetation clearance site to cut down bramble and other light scrub. They should not be used as an axe. The axe back version is not suitable for use by inexperienced volunteers due to it having two sharp edges. Attention should be given to the working area when using slashers. People should be kept clear to avoid any risk of injury from flying material and being accidentally struck. The safest working method is to keep the blade in sight i.e. not raising it above shoulder height and not swinging it round behind the legs.

- Axes: there are many types of axe (e.g. felling, splitting and hatchets). In skilled hands, an axe can fell a tree quicker than it can be sawn down. In most cases the volunteers are unskilled and

therefore axes should not be used for scrub clearance on grounds of safety. They use more energy than a bowsaw and also leave a messy stump.

- Billhooks: can be used to remove small branches from trees. However they can leave a sharp, pointed piece of branch behind. This is unsightly and unsafe, if the tree is to be left. Loppers should be used as an alternative.

- Rakes and Pitchforks: are useful for dealing with brambles and for raking up the small debris. A tarmac rake is useful around the fire as the head has a metal shaft before the wooden handle and helps to avoid the handle getting burnt.

- Mattocks: will be required to assist the removal of stumps when they are winched out. See later Winching

7. SITE VISIT

7.1 Visit the work site in advance of the work being carried out to assess what needs to be done:

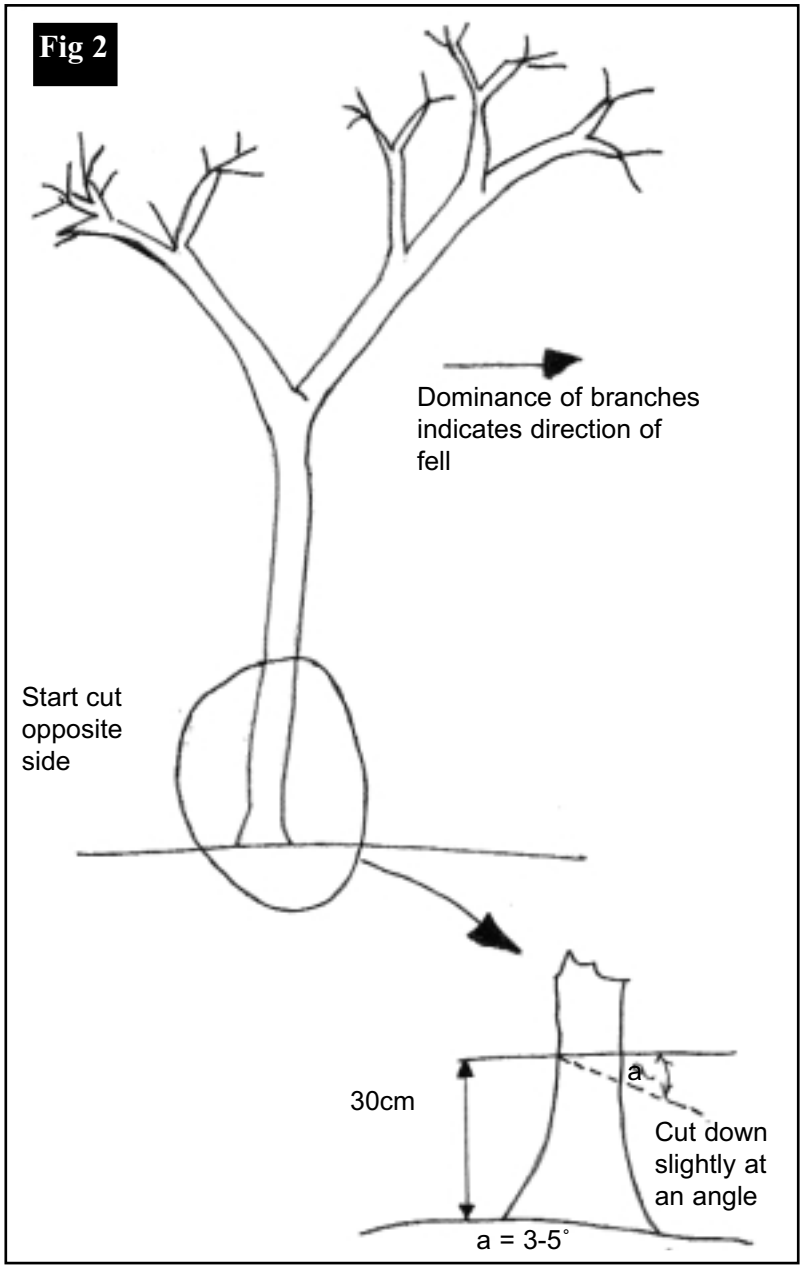
- Hand tools required
- Method of disposal of materials
- Use of power tools
- Dangerous areas on site, banks, infirm ground, overhead cables, rights of way/public access, buildings and roads
- Sensitive areas on site i.e. badger sets
- Marking of large trees for felling
- Landowner liaison, who may have special requirements for the work to be carried out on his land.

7.2 Before work commences ensure that all the volunteers know the work the dangerous and sensitive areas on site and the scope and boundaries of the worksite. It is well worth a walk through the area with them at the start of the first day.

8. METHODS OF REMOVAL AND DISPOSAL

8.1 Felling – Method for saplings up to 75mm Dia.

The trees which are to be removed by hand (outlined above) can be felled quickly and simply with a bowsaw. It should be possible from looking at the tree to see which way it is likely to fall due to a lean or more branches on one side. The tree should be felled in this direction. These trees only require one cut, it is not necessary to remove a wedge first as this is only required when a chainsaw is used. Make the cut 30cm above the ground on the opposite side to the way it will fall. The cut should start with the bowsaw level and run slightly down by 3-5˚. (see Fig. 2) As the cut begins to close on the saw due to the weight of the tree then it can be pushed over with one hand while sawing with the other. Once the tree is over the cut can be finished off, removing the tree from the stump. The material should then be stacked for disposal. The stump can either be trimmed to ground level with handsaw or chainsaw (minimising trip hazard) or winched out (see later paragraph on winching). Make sure that the volunteers work at a safe distance apart.



8.2 Burning

8.2.1 Burning is one method of disposal of unwanted vegetation. If the material has been stacked overnight then the fire should be made next to it, this allows the material to be checked for hibernating hedgehogs and other animals before it is burnt. It is essential that you read PRH "Health & Safety Section 2" if you intend to light fires on your site.

8.2.2 **Precautions and safety rules**

- Never light a fire with petrol
- Never light a fire under trees or power cables and on areas likely to catch fire e.g. dry grass
- Never light a fire in strong wind, as it may get blown out of control
- Discourage the volunteers from lighting a fire on the base of trees even if they are for removal as this will look unsightly even when the tree is felled

- Never over-stack the fire due to risk of it toppling over
- Have means of putting out a fire should it start to spread
- Monitor the wind direction and strength and take appropriate action
- Site the fire so that the smoke from it won't be a nuisance to the volunteers and local residences where possible
- Watch that sparks and flying embers don't set light to anything
- Allow time for fires to burn down before darkness.

8.2.3 Method

Start small, using paper, firelighters and dead wood. Lay all the material one way (making wigwams is not appropriate, see below) and continue to lay everything you put on the fire the same way, with the thick end of the branches at one end (towards the wind where possible). This makes the fire self-feeding. As the material burns away at the bottom the weight of the pile on top keeps the heart of the fire fed. Many fires fail as they get too big too quickly so gradually increase the size, when it is burning well then the green wood can be included. Material that has been put on randomly can support itself which then let's the middle of the fire burn out. Appoint a person to feed the fire to ensure control and supervision. Don't overstack the fire. As the work progresses then separate fires will be required to avoid excessive carrying of the material. Use the same method as above. A good base can be made for the new fire by using some shovel-loads of hot ashes to give it a good start. If the fires are to be used the next day then they can be restarted by stoking the ashes and using any left-over twigs which were on the fire the previous day as these will be dry and burn easily.

8.3 Stacking

Stacking is the environmentally friendly alternative to burning. However it is only suitable for dealing with small volumes of material and where the canal runs through a rural area. With this method the material is stacked in small piles on the non-towpath side of the canal and left to let nature to take its course. The material will rot down over a number of years, at the same time providing a habitat for wildlife.

8.4 Chippers and Shredders

Chipping is an alternative method of disposal of material where burning or stacking is unacceptable. A chipper is a machine that cuts the branches into chips. The machines come in different sizes. They can be mounted on a tractor which provides the power or self contained with their own engine. The larger the unit the quicker it chips and the larger the diameter of branches it can take. The chips can be left on site to break down naturally or the outlet of the chipper can be played into a trailer and the chippings taken off site for storage and possibly sold as gardener's mulch. Only trained volunteers should use them. All the safety precautions listed on the machine and in the handbook should be followed. All personnel in the working area of the chipper should wear ear defenders as the machine generates a lot of noise when in use. This also should be taken into account if working in a residential area and the working day should be adjusted accordingly. Chippers and shredders are expensive units to buy or rent and this should be taken into account when choosing this method. Chippers can only be used on clean waste. If the material is contaminated with stones, soil, nails etc. this will damage the rotating knives or if it is wet or soggy green material it will cause the cutting area to clog up. Shredders however can handle all forms of green

waste as the waste is flailed rather than cut, producing a mulch rather than a chip. However a shredder is not as efficient as a chipper. Shredding material probably requires up to 300% more horsepower per ton than chipping.

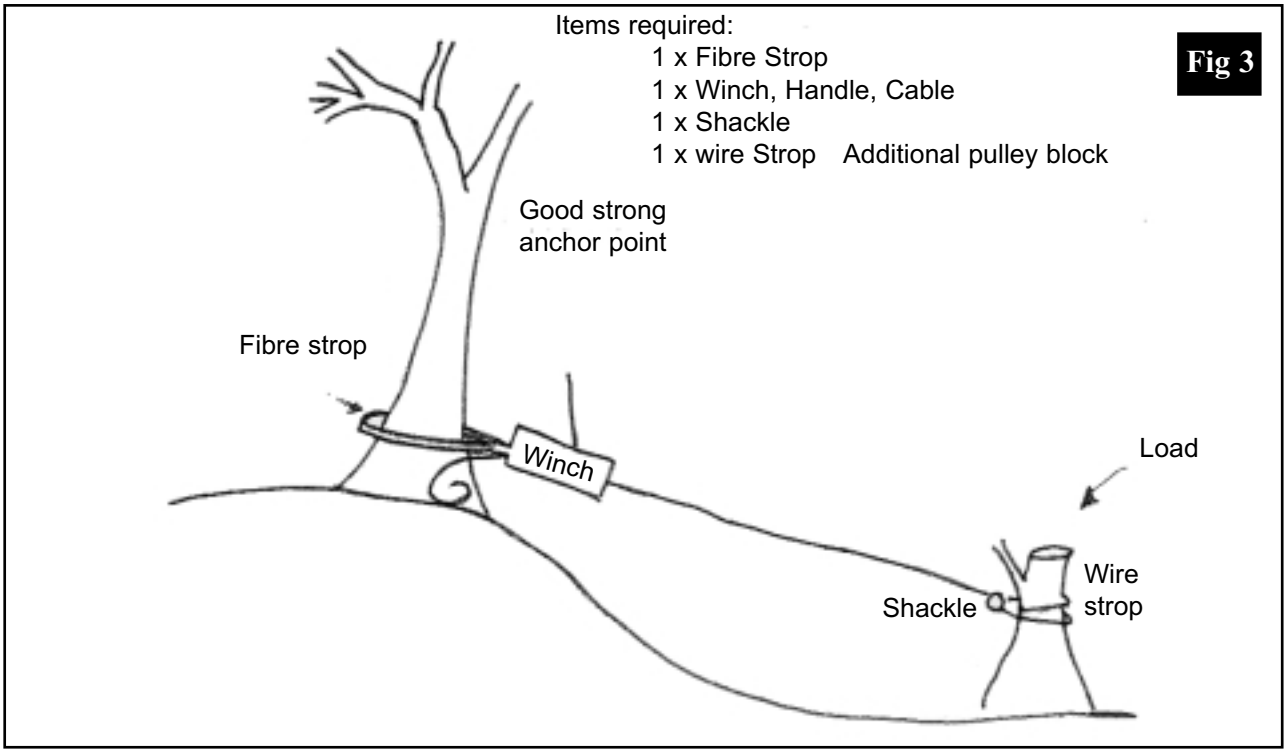
8.5 Removal of stumps

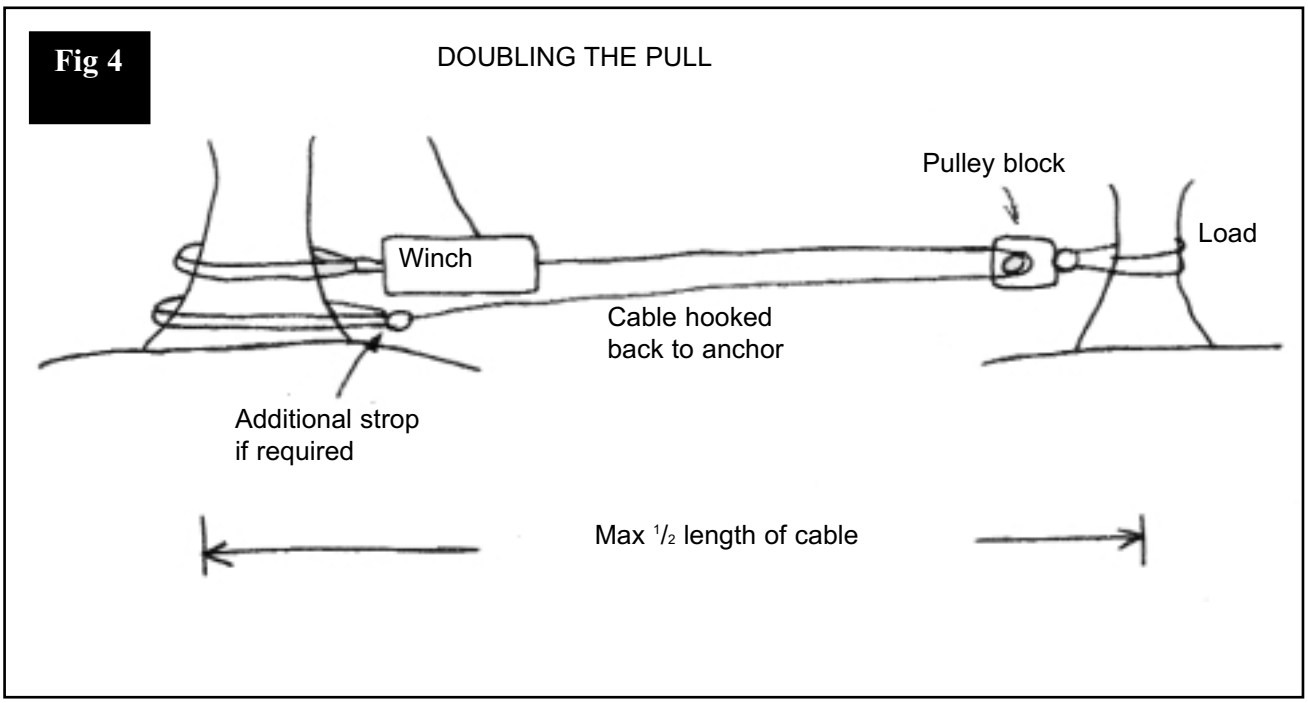
8.5.1 If a tree is cut down and the stump is left then it will start to sprout and grow the following year. This is called coppicing. This can be avoided by: cutting the stump down to ground level and treating it with a coating of diesel, 'Root Out' weedkiller (Amcide, 2,4,5-T) or the stump can be removed by winching. Care must be taken if it is decided to winch it out. If the stump is from a large tree it will leave behind a large hole taking with it the clay puddle (the waterproofing layer of the canal). If as in many cases, the canal is not put back into water until some years later then the location of the hole maybe lost (due to filling up with leaves and other debris) and may cause the canal to leak. It is better to cut the stump off at ground level and leave it until the canal is re-profiled where it can be removed by an excavator and the hole re-puddled at the same time. The other problem with removing a large stump is what to do with it. They are very difficult to burn and can not be sawn up easily making disposal a problem. When tackling the problem with chemicals ensure that the volunteers using them have adequate safety equipment for the chemical being use as per the manufactures recommendations. All weedkillers must be mixed up in the workshop and transported to site in clearly identified containers, any unused chemical must be returned back to the workshop for safe storage and not left on site. All stumps must be treated within 24 hours of cutting to allow maximum effect.

8.5.2 Any chemical used to kill stumps must be suitable for use next to a watercourse and will not adversely affect fish and wildlife.

8.6 Winching

Winching is required not only for the removal of stumps but also for the extraction of felled timber where it has been felled across a water-filled canal. The principles of winching operations are the same. A good anchor point is required. This can either be a large tree, or if removing stumps, another stump which is to be removed (they can be winched together until one or the other gives). However, caution must be advised here that the anchor may start to give first (if this happens then the winch must be swapped around). The anchor should be close to the work (the object to be moved) as most winches only have a cable of approximately 20 – 25M. If the anchor point is a tree which is to remain then the winch should be anchored using a fibre strop as if a cable strop is used it will ring bark the tree (cut the bark due to the load) and it will eventually die. The winch should be attached to the load using a wire strop, which when put under strain will cut into the material, lessening the chance that it will slip off (see Fig. 3). When winching stumps put the strop as high up as possible on the stump so as to maximise the leverage. A good place to put the strop is below a branch or fork in the work. When winching stumps the base will need to be dug out, with as many of the roots being cut as possible, a good use for Mattocks. Do not use the winch cable itself to wrap around the load and hook back on itself as damage will result to the cable, which could result in it failing its next safety test. There are many types of cable winch on the market such as Tirfor. These are available in different sizes, with the load on the side indicating a dead lift, a pull load is equal to twice that of a lift. Putting in a pulley block at the load end and doubling back the winch cable to the anchor point can double the load the winch can pull. This however halves the length of your cable and it could be a problem to find a suitable anchor point (see Fig. 4) The winch is rated for use by a single person. It is possible for two people to stand opposite each other and operate the winch but this





can overload the safety shear pin on the winch handle. Although the shear pins are quite expensive additional pins should be purchased so as to avoid disruption to the work should one break. On no account should anything else be used in place of the correct shear pin for the winch, as damage will occur to the pin assembly, which is expensive to replace, or the winch could be overloaded. Check the cable each day for broken strands and at the end of the day clean the cable by wiping off the dirt ready for use the next time out. When handling wire cables and strops use gloves. All the shackles and strops etc. must be checked with each new pull. The hand winch is technically an item of lifting gear and should be checked over and certificated once a year.

9. CHAINSAWS

In the course of a typical vegetation clearance there will be some trees larger than those suitable for removal by hand. These should be left to be felled by a chainsaw after all the scrub and smaller trees have been removed. Any large trees for **removal** should be marked with either tape or paint (convention) to indicate to the chainsaw operator those which are staying and those to be felled. On no account should any inexperienced people be allowed onto site with a chainsaw. Only those who have undertaken the required competence test approved by the National Proficiency Test Council, NPTC and who have a full set of safety equipment should be allowed to work. A chainsaw should not be used above waist height when the operator is stood on the ground. If there is a need to cut something above this then the operator must again be properly trained and equipped to climb and cut above ground. The chainsaw operators can follow on from the volunteers who are carrying out the light clearance but only if a 'no go' zone has been established between them. The size of this zone is two times the height of the tallest tree being felled. As the chainsaw team pass through the site it will be necessary for the volunteers to go back through after them to tidy up the branches and to stack timber. The same no go zone should be set up. An experienced and vigilant member of the ground staff will need to be appointed to the chainsaw operator to provide support and in the control of people in the safety zone. It is often unavoidable for the chainsaw operator to fell the tree anywhere else apart from over the canal due to the lean. If the canal is filled with water then a winching team should be set up to extract the tree so that it can be logged up later.

10. BRUSHCUTTERS/STRIMMERS/CLEARING SAWS

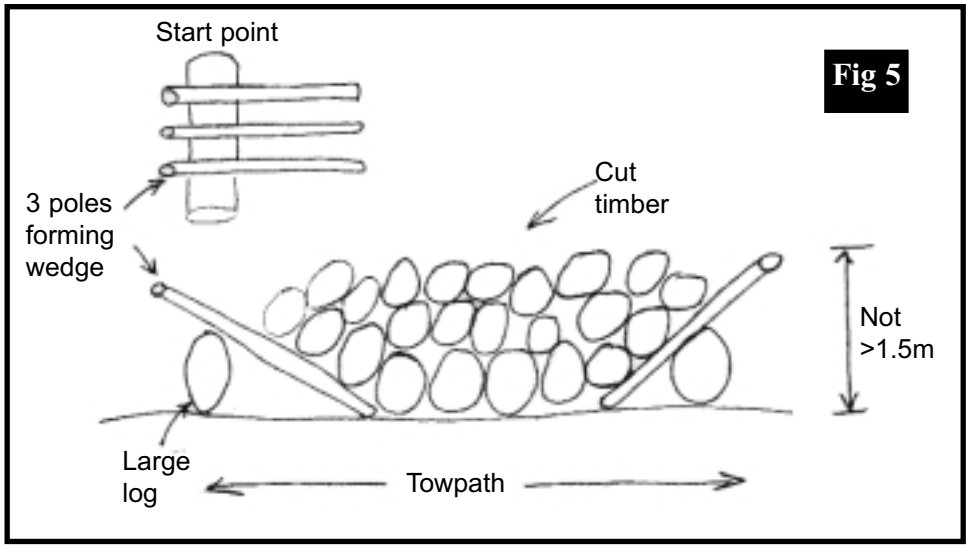
All operators should have been trained in the safe operation and be able to carry out the necessary routine maintenance before being allowed to use this item of equipment. The minimum requirement for safety equipment is goggles and ear defenders, but it is recommended that full face protection is used rather than goggles to prevent misting and provide additional protection particularly when brushcutting. Plastic over trousers are also advisable when strimming grass to avoid contamination of the operators clothes from animal excreta. Brushcutters are used on areas which can not be reached because of the terrain with other types of mowing equipment. Depending on the engine rating different tools can be fitted to handle vegetation from grass to brambles and small trees to a diameter of approx 10mm.

11. STACKING TIMBER

When the chainsaw operator logs up, the logs should be five feet long as this helps with the stacking. Although a five-foot length can be heavy (caution the volunteers about safe lifting and working in pairs) they are easier to transport and require a smaller number of trips to the stack than small logs. To start a pile, place a large log on the towpath at right angles to the canal. Place three poles on it to form a wedge. The logs can be stacked up against this preventing them rolling away. The other end to the pile is also completed in the same way (see Fig. 5). Care must be taken when stacking timber to prevent the pile from toppling over and therefore the height should not exceeded 1. 5 Metres.

12. SALE OF TIMBER

Many of the trees, which grow in old canals like Willow and Alder, have no commercial value and much of the wood is rotten from the inside out. If it is left to dry out undercover it can be sold as logs but does



not fetch the same price as Oak or Ash logs as it is faster burning. The sale of logs provides an income, which can cover the costs of the chainsaw on site. If there are some hardwood trees of a substantial size like Oak it is worth approaching a local timber company for a price. If there is a suitable place to extract it they may fell and take the whole tree as one.

13. TRANSPLANTING

The costs involved with hiring the relevant machinery or engaging a contractor to move and transplant trees is prohibitive. It is not only the costs, which makes this un-viable but access. The location of the trees, which in many cases are on steep banks or in cuttings, means that the heavy machinery is unable to reach them without doing costly damage to the area and the bed of the canal. Small saplings can however be moved by hand but this is only worth doing if it is a deciduous tree like Oak or Ash.

14. RE-PLANTING

Replanting is the cheaper alternative to transplanting. Environmentally for every tree cut down one should be planted to replace it in a suitable area. This can be done by creating a new wood in a corner of a field or along the non-canal side of the towpath. The spacing between the whips (young tree about one metre in length with root) depends on the species of the tree being planted. To avoid the whips being eaten by rabbits and other animals they should be put in a tree shelter (a translucent plastic tube). This should be staked to avoid it being blown away. The stake should be driven into the hole before the whip is planted so not to damage any of the roots.

15. FOLLOW UP WORK

The area that has been cleared if not dredged and put back into water will rapidly return back to being covered with vegetation, this is accelerated by the fact that the whole line of the cut has been opened up to the light. This can happen in a few growing seasons if the area is not maintained. If this is the case then regular maintenance i.e. strimming the grass and an annual trim and cut back will be required to avoid regression. If any trees or vegetation has been planted this will also require regular maintenance.

16. FURTHER READING

Available from HSE Books PO Box 1999, Sudbury, Suffolk, CO10 6FS
Tel: 01787 881165 Fax: 01787 313995

- Management of Health and Safety at Work Regulations 1992
- Provision and Use of Equipment Regulations 1992
- Manual Handling Operations Regulations 1992
- Personal Protective Equipment at Work Regulations

FASTCo produce a series of free safety guides
Forestry & Arboriculture Safety & Training Council
231 Corstorphine Road
Edinburgh
EH12 7AT
0131 314 6193/6247
www.forestry.gov.uk/fastco.html

- No. 203 Clearing Saws
- No. 304 Cross cutting and manual stacking
- No. 310 Hand winches for directional felling and takedown
- No. 604 Mobile chippers
- No. 802 Emergency planning and first aid

Practical Restoration Handbook

Towing Paths

by Rachael Banyard & Diana Smurthwaite

CONTENTS

1. TOWING PATHS (commonly known as towpaths)

Traditionally, a towpath was designed to allow two horses to pass, and for a hedge to grow on company land to provide a stockproof barrier to the adjacent land. Thus the width of a typical towpath would vary between 1.8 and 3.6 metres, depending on usage. Since the introduction of motorised boats, coupled with the lack of maintenance, hedges have become wider, and the canalside banks have subsided, consequently the towpath widths have been considerably reduced.

Tools and Equipment Needed

(a) Hand tools: mattocks, shovels, pickaxes, sledgehammer, hand roller, wheelbarrow, spirit level, length of timber to use as straight edge

(b) Machine tools: mini-excavators, small dumper trucks, rollers (either pedestrian-operated or ride on), vibrating plates

Materials

Timber used for edging (100mm x 25mm) must be pressure treated with preservative.
Semi-permanent membrane/geotextile, e.g. Terram; Puddling clay; Bentonite.
Select from: cobblestones; paving blocks; crushed stone 20mm down; concrete; tarmac.

Health and Safety

- Wear steel-capped footwear, hard hat and strong gloves.
- Wear eye protection when splitting or shaping stones, cobbles or paving blocks.
- Ensure operators of mechanical equipment and dumper trucks have received the appropriate training. If they are working close to the canal, they should receive particular site briefing and instruction.
- When swinging a mattock or pickaxe, ensure that no-one is within 2 metres of the user. Make sure that feet are balanced and firmly placed.
- Where weedkillers are to be used, suitable protective clothing must be worn, together with face masks and eye shields. The herbicide should be used strictly in accordance with the manufacturer's instructions.

Terms Used

Campshedding The protection and retention of a canalbank with timber, steel piling, concrete blocks, sand-bagging or stone-filled gabions.

Gabions Rectangular woven heavy gauged galvanised steel wire container filled with quarried stone, gravel rejects or similar.

Membranes Semi-permeable lining of matting or filter cloth, which allows the passage of water whilst retaining particles of solid matter.

Piling Cantilevered sections of solid steel with interlocking clutches, driven into the canal bed to provide firm strengthened edges to canal and towpath. Timber can also be used for piling, e.g. elm, oak, greenheart, pitch pine.

Revetment A facing of masonry, concrete, steel piling, or gabions, to support a canal bank.

Towpath Construction/Restoration

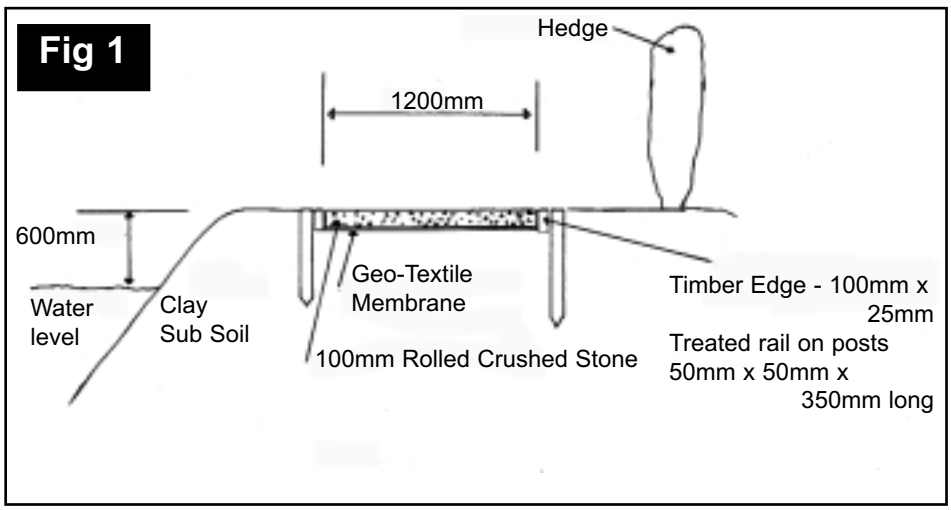
With today's permitted access to the canal network, towpaths have been subjected to intense usage compared to their original designation. Accordingly, their construction and maintenance needs to reflect this. For instance, the towpath is often used now by anglers and cyclists as well as walkers, and also by wheelchairs, pushchairs, etc., and the width will need to be sufficient to allow for these. In rare cases, the towpath is also a bridle path, so horse riding is permitted, and in other areas horse-drawn boats are still in operation. A locally distinctive solution should always be sought and a thorough survey and analysis of the site should be undertaken to derive an acceptable solution. Towpath construction will vary according to the location and usage of the canal, e.g. stonechippings and grass on a rural canal, to the cobbled towpaths of a busy industrial canal.

In areas where the towpath has collapsed into the canal bed, then the bank must be reinstated by campshedding. Details of the various methods of bank protection are given in other sections of the I.W.A. Practical Restoration Handbook.

The offside of the towpath will usually be protected by a brick or stone wall or a fence in urban areas. In rural areas, a hedge, a dry stone wall or stone faced retaining wall, or a fence could be used.

(A) Rural Towpath

A typical rural towpath is shown in *Fig 1*.



Method

1.1 Scrub-bash/clear vegetation back to original line of the hedge.

1.2 Remove any stumps, and fill in holes with puddling clay if path is level or below water storage.

1.3 Fill any breaches in the towpath by clearing back to original clay and puddling up to the correct height. The finished towpath level is normally 600mm above water level.

1.4 Dig down and fill in rabbit holes. In the case of an extensive warren, it may be necessary to dig a trench along the length of the warren, and fill with bentonite to reseal the bank.

1.5 Scrape away the topsoil, either using mattocks, spades/shovels, and a wheelbarrow, or a mini-excavator to remove excess. The aim should be to produce a level sub-surface 1200mm wide and 100mm below finished towpath level. It may be necessary to treat the area with systemic weedkiller.

1.6 Set in edge boards, consisting of 100mm x 25mm of treated timber, held in place by wooden pegs.

1.7 The sub-surface is now ready for the finished surface to be laid. First lay a geotextile semi-permeable membrane, such as Terram, over the area. This helps to prevent weed growth up through the towpath, and also allows water to drain through, to prevent the path becoming waterlogged.

1.8 Spread a bed of 20mm down aggregate with sufficient fine material to fill the interstices. Level this and compact it to a depth of 100mm, using either a vibrating plate or a 300-500kg vibrating roller.

Urban Towpaths

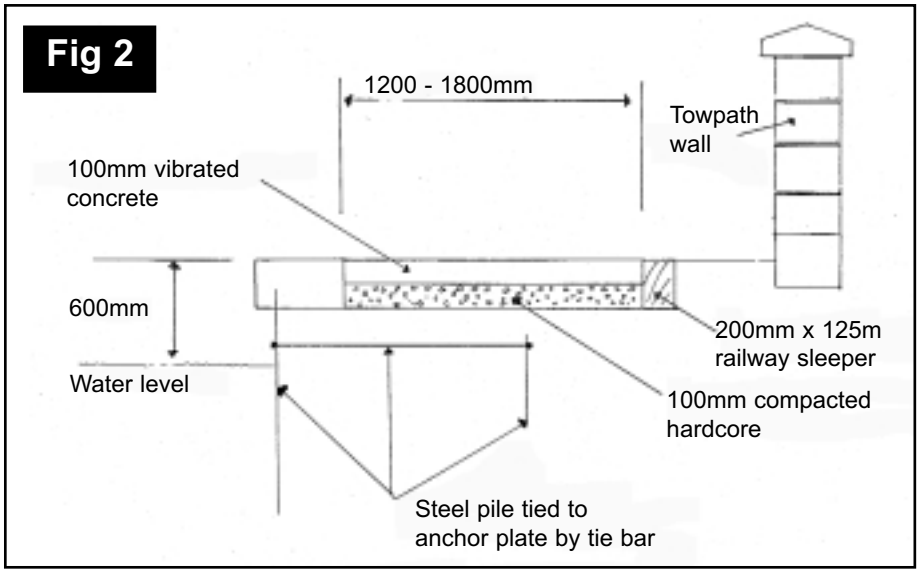
In urban or industrial areas, the towpath is subjected to a great deal of use, often with vehicular access, and therefore the towpath must be constructed to take the impact. Canal sides will probably be either concrete capped steel piling or brick/stone walls topped with large coping stones. To encourage pedestrian use, there should be provision for bench seating, picnic tables, litter bins and dog excrement bins. Notices should be erected at access points requesting dog owners to remove their dog excrement and dispose of it in the nearest bin provided, and for walkers to use the litter bins. Both types of bin will need to be emptied on at least a weekly basis. The towpath foundation should consist of at least 100mm of well compacted hardcore.

The surface finish can be a choice of:

(a) 75 - 100mm Tarmac.

(b) 100mm of concrete (well vibrated).

(c) Stone setts placed on a 25mm bed of sharp sand.



(d) Precast interlocking grass/concrete system. The concrete provides the load bearing surface, while the network of holes filled with soil and grass seed give a more natural appearance.

(e) Clay bricks.

(f) Aggregate/hoggin.

(g) Clinker/ash.

Method

1.9 Clear any vegetation and accumulated top soil from surface and coping stones. If vegetation is extensive, the roots may cause the coping stones to dislodge and old surface of the towpath to lift. Remove the coping stones and eradicate the roots if possible before reseating the stones and resurfacing. Treat if necessary with systemic weed killer. Advice should be sort as to the most appropriate systemic weedkiller to control particular weeds at each location.

1.10 If surface is uneven, it will have to be raised to level off any bumps or hollows. In cases of serious neglect, it will almost always be necessary to lift the existing surface, and ensure that the sub-surface is level.

1.11 If possible, re-use existing material to match previous surface.

1.12 Ensure that the path remains parallel with the canal (except the run off to turn pike bridges, etc.) and parallel within itself. The profile of the surface should be maintained, with a slight slope downwards towards the canal to provide run-off [see also 'Drainage' (b) below].

Mooring and Landing Places

(i) At designated and other regularly used moorings (for shops, pubs, etc.) and at lock or moving bridge landing points, the grass should be mown to the water's edge.

(ii) Mooring rings or bollards should be provided at all designated or popular mooring sites and at official landing points, and these should be attached to a firm concrete foundation.

Drainage

All towpaths need to allow surface water to run off, either into the canal or into a side ditch. Sometimes it may be necessary to collect the water into a side ditch and then feed it into the canal via pipes running under the towpath. Where the banks have been piled, 50mm holes should be drilled in every fifth pile above maximum water level at a height of 100mm.

Likely problems that could be encountered include:

(a) Canals in a cutting. Some form of drainage will be necessary for the run-off from the slope above the towpath. This could be in the form of a ditch alongside the path, which could drain into a stream at the end, or pipes could be incorporated from the ditch underneath the towpath, with a fall of approximately 1 in 30, to drain excess water into the canal.

(b) Canals on level ground. A slight slope of 1:30 needs to be incorporated into the towpath to drain any excess water into the canal. (British Waterways, 1972).

(c) Canals on embankment. The slope should be towards the hedge or drainage ditch.

Where drainage is a problem, it is essential that the area be thoroughly surveyed, to draw up a drainage plan prior to commencement of work.

Maintenance

On rural towpaths, the vegetation will have to be kept under control during the growing season by regular mowing, and the hedges kept trimmed back. If there is a gravel path, this must be repaired if erosion occurs. Any hedgerow trees must have overhanging branches kept trimmed back flush with the trunk, leaving an overhead clearance of 2.0 - 2.5 metres above the towpath, and any suckers or seedlings removed. Repeated cutting back by machinery of some tree species, e.g. elder, coppices them and can encourage vigorous growth. A regime for removal or poisoning of such roots should be an essential part of towpath maintenance for those growing between path and canal.

Urban towpaths should need minimum maintenance where there is regular normal usage. Annual spraying with systemic weedkillers might be advisable, and any surface damage needs to be repaired as soon as practicable to prevent further deterioration, and to avoid accidents to walkers, e.g. tripping on uneven surfaces. There is also a possibility of vandal damage, and therefore the urban towpath should be inspected regularly.

Access

Access to towpaths should be considered from all roads crossing the canal, either on bridges over, or (in the case of aqueducts) under the canal. What type of access will depend on several factors:

(a) In an urban situation, it may be necessary to provide access for vehicles for maintenance purposes. The entrance would need to be at least 3.2 metres to allow sufficient space for turning

into the access. Vehicular access could only be provided where sufficient land was available. A slope would need to be constructed, with hard surface, at a gradient no steeper than 1:14.

(b) Disabled access should be taken into consideration on all rural or urban access points, but British Waterways advise that there are towpaths that are unsuitable for wheelchairs and disabled walkers, on the grounds of safety. Some urban towpaths are unavoidably narrow, due to the proximity of walls and buildings. Rural towpaths are also sometimes narrow, as no more land is available to increase their width; they can also be unstable and unsuitable for all wheeled vehicles, including wheelchairs, due to local soil conditions, e.g. clay or peaty soil, which quickly becomes rutted and waterlogged (Department of the Environment, 1997). In such cases, a notice should be erected at the access point explaining the dangers. Where the towpath surface is suitable for wheelchairs and disabled walkers, a slope with hard surface from the access point would be necessary, and it is recommended that this should be no steeper than 1:12. If a gate is set in at the top of the slope, it must be remembered that this should have low set catches to be reachable from a seated position, and should close automatically.

Stiles or kissing gates should not be positioned where disabled access is to be permitted. This also applies to access for perambulators, bicycles, etc.

(c) Local byelaws may decree that the towpath is for pedestrian use only (Department of the Environment, 1997). In this case, to discourage use by bicycles, horses, wheeled vehicles (including wheelchairs), a stile or kissing gate (Figs. 3 and 4) is advisable at the top of the slope. A further discouragement to non-permitted users would be to build steps instead of a slope. These should be constructed of timber risers - either railway sleepers or similar size treated timber, or straight logs, cut to 2 metre lengths. Half-round fencing stakes, 100-150mm width, and at least 500-600mm length, should be driven in at either end of the risers, with the top level with the top of the step, and bevelled downwards 45 degrees. The treads should be filled with gravel or crushed stone to a depth of 25-50mm. A handrail should be provided on the exposed edge of the steps. If the steps are placed at right angles to the towpath, it will also be necessary to provide a guard rail along the outside of the path opposite the bottom of the steps to prevent accidents.

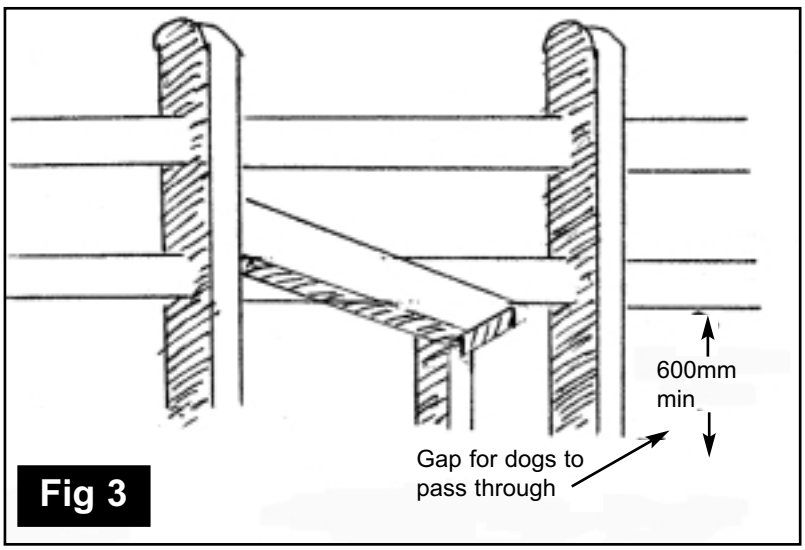
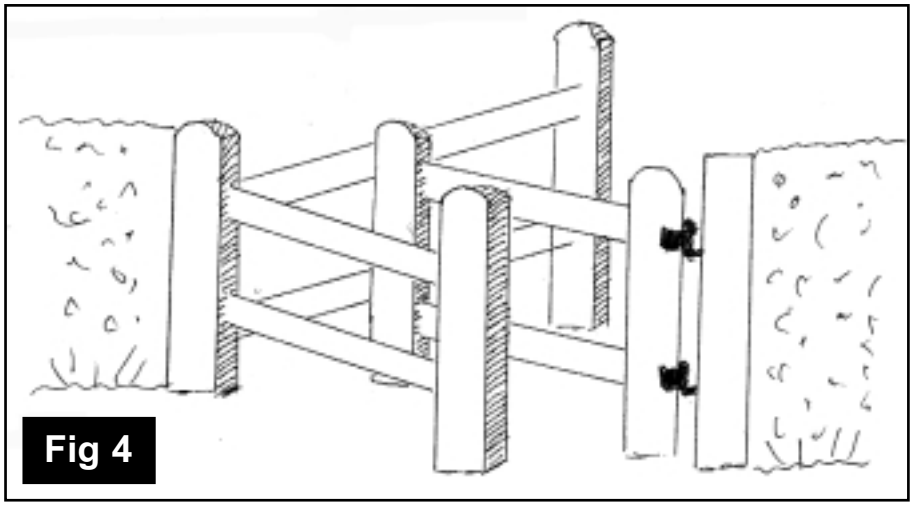


Fig 3



In popular areas, and where space permits, seats can be provided beside the towpath at intervals.

2. STONE WALLING/STONE-FACING AN EARTH BANK

Stone is often used to face and strengthen an earth bank above or below a towpath, or the wing walls above and/or below a lock, particularly on the towpath side. This can also be referred to as a retaining wall or structure. This is *not* a dry stone wall (see next section). The following methodology is suitable for use when repairing/restoring existing structures. However, if a new structure is to be built from scratch, it is advisable to seek the advice of a structural engineer.

The following advice is suitable for rural areas. In urban areas, to prevent vandalism, it might be advisable to use mortar in the construction process. See also chapter on 'Brickwork' by John Park.

Tools Needed

Digger (like a one-sided mattock - if not available, use mattock); shovel; crow bar; wrecking bar; lump or club hammer; stone walling or brick hammer; strong chisel; bolster.

Health and Safety

- Wear steel-capped boots, hard hat, strong gloves
- Wear goggles when cutting or shaping stones
- Keep stone to be used in wall back from working area to avoid tripping
- Spread large stones in front (smaller stones behind) to shorten distance for carrying/lifting
- Never leave tools lying in hazardous positions
- If wall is to rise higher than 1.5 - 2 metre, scaffolding rather than a ladder is safer
- Lifting - correct position for lifting is very important. With knees bent, and back straight, lift carefully. Never strain - if stone is too heavy, obtain help to lift.

- Be careful not to trap fingers when lowering stone into place

Terms Used

Foundation stones	Large, heavy stones used at base of wall to provide solid foundation
Faces	The 'best' side (and the only visible side) of stones used in the wall, the face preferably being flat
Tie stones	The longest stones used at intervals in the wall, running lengthwise into the bank, to provide stability and strength, and to tie the wall to the bank
Trigs	Small stones used to wedge behind a larger stone with an uneven base, to ensure that it 'sits' securely
Coping stones	Large stones used along top of wall, preferably with flat top as well as flat face, to be used particularly where it is anticipated that walkers and boaters will want to walk along the top
Pitchers	A line of smallish stones, usually upright (but can be placed at 45 degrees), packed securely along top of wall to form a castellated finish, where it is not anticipated that people will walk/stand on top.
Batter	The vertical shape of the wall, preferably concave in the middle, with no bulges
Infill	If stone-facing tow path wall above water level, this will consist mainly of soil, but for below water level (as in wing walls of lock), clay should be the main infill material to provide the puddle or water-tight seal between and behind the stones. Never use loose stones and rubble between or immediately behind the stones (as in a dry stone wall), as this will not provide the necessary watertight seal required. Water can wash in between the front stones and loosen them, and in winter may freeze, the ice swells, and the front stones are actually pushed out.
Quoin	A wall corner or end

Method

2.1 Using digger or mattock and shovel, dig out bank to firm sub-soil at base of bank to be faced. Any stones removed for re-use (or brought in from elsewhere) should be spread at least six feet back from working area (makes it easier and safer to work), with the larger stones nearest to the working area, smaller stones behind. Any soil or clay dug out should be piled either on top of the bank, or nearby, for use later as infill.

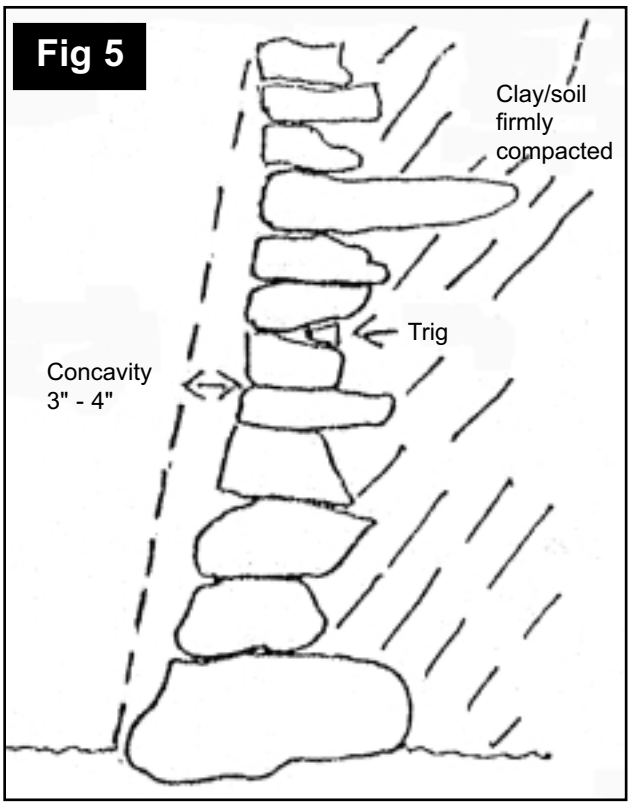
2.2 Lay foundation course, using largest and heaviest stones - not only are these difficult to lift up onto higher courses, but they give a firmer base. They should be placed lengthwise into the wall to give added strength, with the face (best end) at the front. If they have an "ugly" (misshapen)

bottom, try to dig the shape in the sub-soil first, so they sit firmly. The face should have a slight slope outwards to assist drainage, so that the upper edge of the face is 6-8cm further back than the base (see "batter"). The stones should be placed as close as possible to the earth bank behind, if necessary cutting holes in the bank to run the point of the stone back in.

2.3 Infill should then be used to fill all the gaps behind and between the foundation stones, using some pointed tool, e.g. a strong chisel, to poke as much infill as possible between the stones and fill every gap. The infill should then be rammed down very firmly, using the head of a club hammer or the top of the chisel, until it is no longer possible to move the stones by hand. The infill should then be loosely banked on top of the stones, and slightly higher than the stones at the back. This provides a good bed for seating the next course.

2.4 Proceed with next course of stones, taking care to break the joints as in bricklaying. Small trigs or wedge-shaped stones can be used if necessary behind the stones in the face of the wall, only behind, and they should be firmed in securely with infill.

2.5 The batter of the face is very important; it should never be convex, and a concave batter should be the aim (see Fig 5). However firmly the infill has been packed, some settlement of the bank will occur over the years, which may push the face out slightly, but if sufficient concavity has been allowed, the bank should not be weakened. Any bulge in the face of the wall is a potential weakness. The batter will be most pronounced on the foundation course, and each successive course should then have a slightly decreasing degree of batter, with the top layer being set with perpendicular faces.

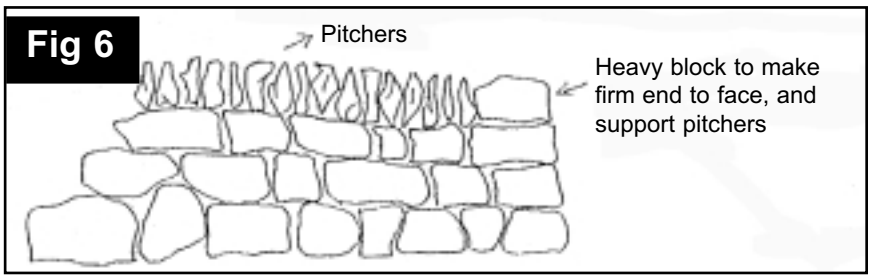


2.6 After each course of stones is laid, repeat the soil/clay infill, and hammer down securely, always leaving the level of the infill slightly higher at the back. If every third or fourth stone placed is a long one, running well back into the bank, this will strengthen the wall. With a long narrow stone with a nice flat side, it is always tempting to use it along the face, both for appearance sake and to make the wall-building faster, but this does weaken the wall. Try to avoid using any stone that is less than 24cm long running back into the bank. Where a shortish stone has to be used, try to use longer ones either side to wedge it in securely.

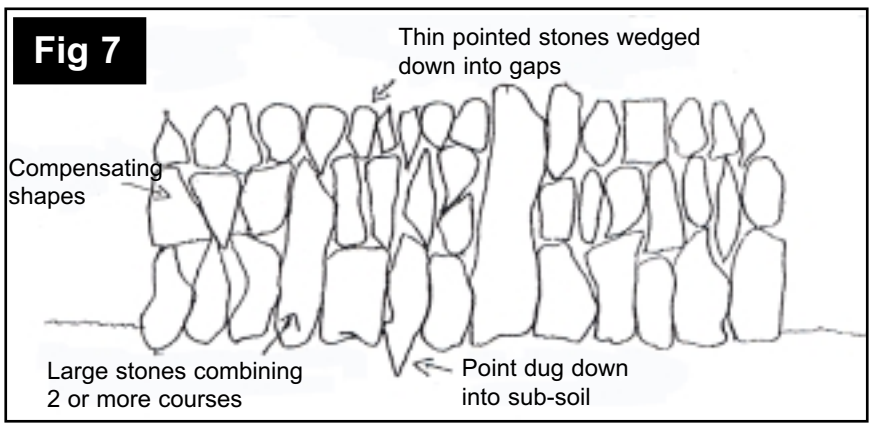
2.7 If the face of the stone is not absolutely flat, or has a corner missing, never use small stones pushed into the gap in the front of the stone bank. Small gaps do not matter in the face, provided the infill is puddled well between and behind the stones to form a watertight seal, but if necessary

(and section is below water-line), a ball of clay can be pushed firmly into bigger holes in the front. A point sticking out of the face may be "dressed", or re-shaped, using brick hammer or club hammer with chisel/bolster. Remember that some stones are quite soft and/or brittle, so if requiring to re-shape, tap gently at first, otherwise a good stone may shatter and be unusable.

2.8 The top course of the wall can be finished by using one of two methods. If it is necessary to walk along the top of the bank, e.g. for boaters mooring at one end of a lock, large flat coping stones are the most appropriate. A second method, which could be used along the top of a towpath bank or round the edge of a side pond with stone-faced sides, is to use pitchers (see terms used and Fig. 6). This is also a practical method of using up irregular shaped stones that cannot be used in the wall, and it helps to retain the soil along the top, as it can be packed down securely between the pitchers. However, if repairing a section of bank where neither method has been used, it is obviously important to try to match the sections either side.



2.9 An alternative method of construction, which is particularly useful if most of the stone available is rough and misshapen, is to place the stones on edge in the wall (rather than flat), again with the stones running back lengthwise into the bank. Using this method, the courses do not have to be level, but stones of greater depth can be used, as these will combine two or even three courses to give greater tying effect. (see Fig. 7). If large rounded stones are to be used, this method is the strongest, as the stones obviously do not lie flat on the courses below as they would with the horizontal method.



Whilst most walls will be built into the bank at either end, it may be necessary to construct a quoin (or corner) at the end of a length of wall, e.g. at either side of a stile or gateway. The quoin can take either square or round forms.

(a) For a square end, select large slab type stones, preferably rectangular in shape, with at least two faces at right angles. To lay the foundation course, place a rectangular stone on either side of end and infill any gap between (narrow face) with a stone of similar depth (see Fig 8). Next course, lay two stones with inside ends meeting and long edge to wall end. Continue laying stones as in brickwork, alternating long and short faces, thus enabling the builder to maintain the bond and have no straight joints, in order to retain maximum strength (see Figs 8 and 9).

(b) A round end can be softer and more natural looking. Select slab type stones whose width is not more than 25cm, unless dressed to curve. If none available, select stones with broader face than back. This will maintain the wall end curve while keeping stones butted tightly together (see fig 10 - page 20).

NOTE: Where rectangular shaped stones have to be incorporated, a few triangular or wedge shaped stones will help to accommodate them.

Fig 8

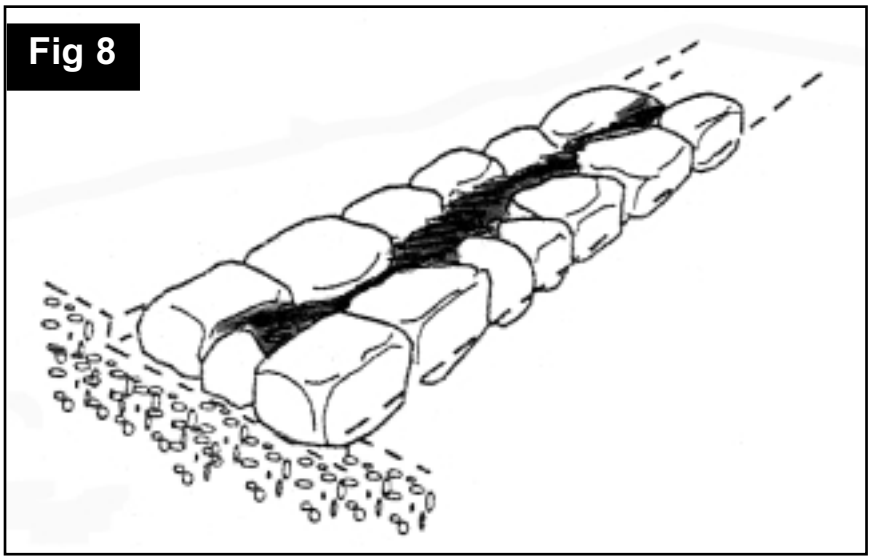
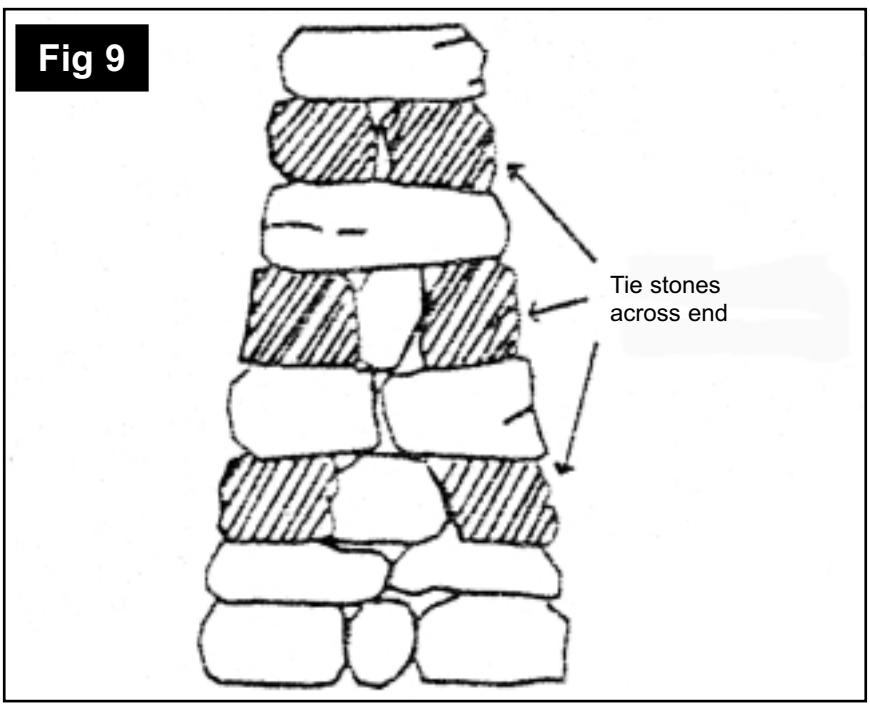
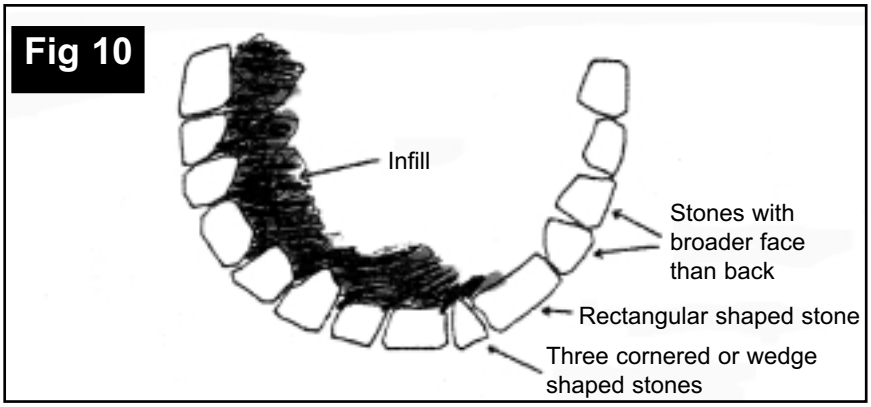


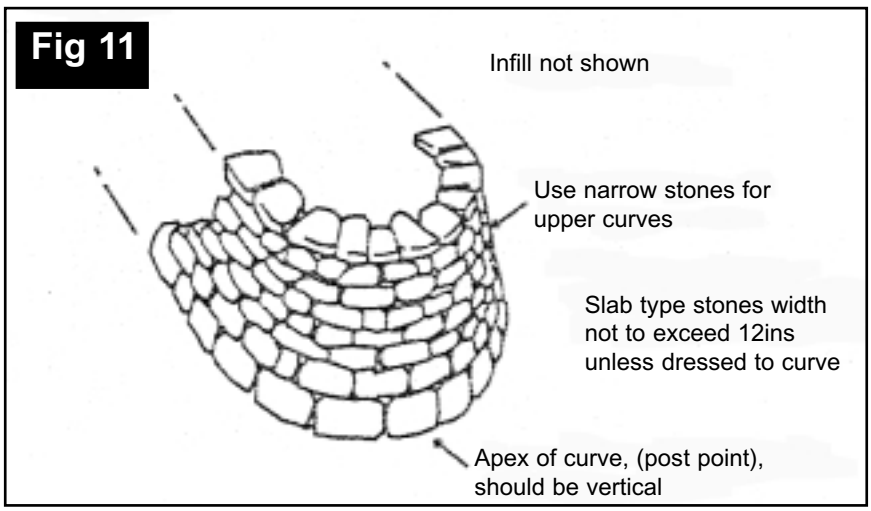
Fig 9

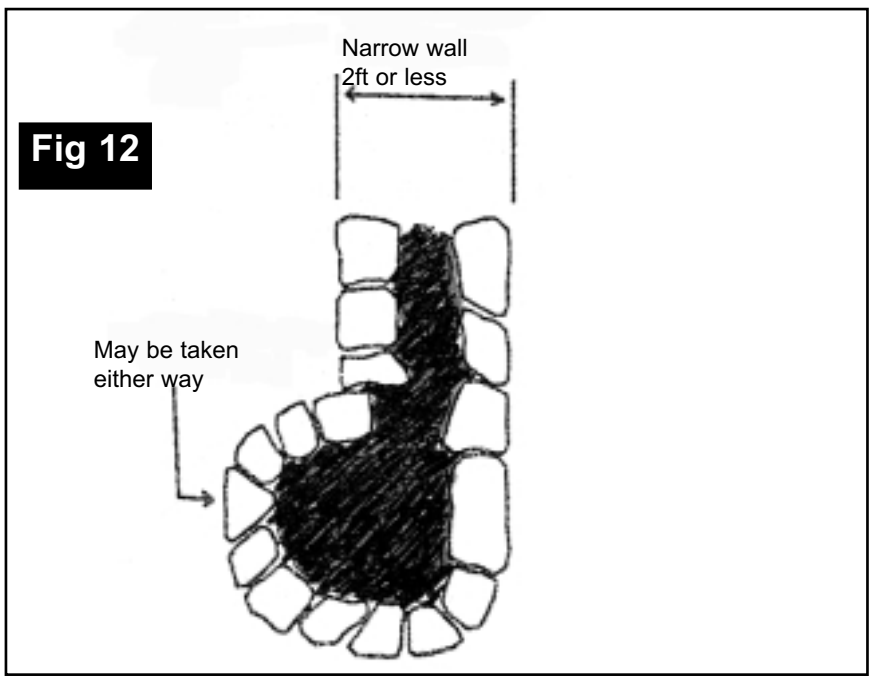




Maintain semi-circular shape of end as build proceeds and tie joints as in wall sides (see Fig. 11). Select narrower stones for the upper curves. Be careful to maintain batter as in wall sides, and keep up infill as each course progresses. This may leave a small gap between top of wall and gatepost/stile, but as infill settles this will reduce.

NOTE: If the wall is narrow in width, say 600mm or less, an extended pier type round end is advisable (see Fig. 12) (Devon Rural Skills Trust Code of Practice, 1995).





3. DRY STONE WALLING

This is not to be confused with stone-facing an earth bank. A dry stone wall is a stand-alone wall, using nothing but stone to construct (including infill), and is built to shed water or allow free drainage through the wall. It can sometimes be seen alongside a towpath where the ground is flat, as an alternative to a hedge.

There are two types of dry stone wall - single-skin and double-skin. The latter consists of two parallel walls, with a "face" on each side, and stone rubble infill. Where available, long stones are built into the wall to tie both sides together; the whole wall would be at least 750mm wide, and can be much wider.

A single-skin is narrower, and therefore not so strong, but takes less stone, so may be the only option. The waller concentrates on maintaining one good face, and the "off-side" may be quite rough. With no backing to the stones, it is less easy to build a firm, stable wall, and it may be necessary to use more trigs to maintain individual stones at the right angle, and to prevent rocking.

The tools needed will be as in section 2, and the health and safety advice also applied. The diagrams will also be similar.

The terms used are also similar, with the exception of the infill, which consists of small loose stones and rubble, and any stone that is unsuitable for use in building the faces of the wall.

Most dry stone walls are traditionally topped with a row of pitchers - sometimes two rows, which are with one row slanting one way, and the next the other, to give a herringbone effect. A single row of pitchers can be either built with upright stones tightly packed together, or a castellated effect can be achieved by building alternate upright and flat stones. However, the aim should be to use whatever method tends to be used locally to maintain tradition. In places where there is a problem with vandalism, with stones from the wall "disappearing" the pitchers are sometimes mortared together. The main wall will still be a dry stone wall, but at least it makes it harder for the odd stone to be removed.

4. HEDGELAYING

There are two main reasons for laying a hedge. One is to preserve the hedge, and encourage new growth, to prevent it dying back. The other reason is to provide a stock-proof barrier, particularly where stock are being kept in a field adjacent to the towpath - or even to prevent towpath users from straying into a field where crops may be planted.

Different styles of hedgelaying are adopted in different parts of the country, and the main one described here is a variation of the Midlands style, where the hedge is growing from ground level alongside the towpath.

Hedgelaying can only be done between October and March, when the sap is dormant, and the trunks less brittle, and more flexible.

The best species for laying are hawthorn, blackthorn, beech, hornbeam, hazel, holly. Others, e.g. oak, maple, spindle, elm and willow or even dog rose, can be used where there is nothing else suitable. Unsuitable species, e.g. elder, alder, ash and sycamore, are best cut out of the hedge if there are sufficient trees/saplings available, and should only be used as a last resort.

Tools Used

Bill hook

Felling axe

Bow saw/pruning saw

Chain saw (if necessary)

Wooden stakes or crooks

Mallet

Hethers, if available (long thin rods of hazel or willow)

Health and Safety

- Hard hats, steel-capped boots, stout thorn-proof gloves, and safety glasses are all advisable.
- It is not recommended that edge tools (bill hook, axe) are used in heavy rain, as they are liable to slip from the hand and cause an accident.
- When swinging an axe, ensure that no-one is within 2 metres of the user. Make sure that feet are balanced and firmly placed.
- When a tree is being either cut out of the hedge, or is being laid, due warning must be given to all people in the vicinity, and the only people closer than two lengths of the tree should be anyone giving direct assistance to the hedgelayer in lowering the trunk gently in line with the hedge (Health & Safety Executive).
- Edge tools should always be kept very sharp. It is a misconception to believe that blunt tools are less likely to cause an accident - apart from being harder work to use, they are more likely to bounce off the tree instead of cutting into it, and can still cut into flesh! A blunt tool will also make a messy wound rather than a clean cut one that would heal easier. Sharpen tools before and after every day's use, and during the day as well if necessary. Many mass-produced axes and bill hooks sold today have too thick a shoulder for efficient cutting, and it is advised that the blade is ground thinner if a grinding wheel is available.
- Many accidents are caused with bow saws, usually because they slip or catch on nearby twigs, and jump onto the user's other hand.
- Always cut or chop away from the body and limbs.
- Overhanging branches or brambles to be cleared to avoid arresting cutting action.
- Avoid wearing loose clothing, flapping jackets etc.
- If chain saws are necessary, (particularly with a very mature or neglected hedge), the user must have a valid chain saw certificate for cutting the width of trunk available, and must always wear at least the minimum safety clothing, i.e. chain saw helmet, visor, ear defenders, chain saw gloves, boots and trousers/leggings. As with axe work, ensure that feet are balanced and firmly placed.
- Check current immunisation against tetanus.

Terms Used

Pleachers, plashers, steepers: All terms used to describe the tree/sapling that is being laid in the hedge.

Hethers: Long thin rods, usually hazel or willow, that are woven along the top of the laid hedgebetween the stakes, to provide a neat and firm finish, and hold down the pleachers in position until they have become used to growing at their new angle.

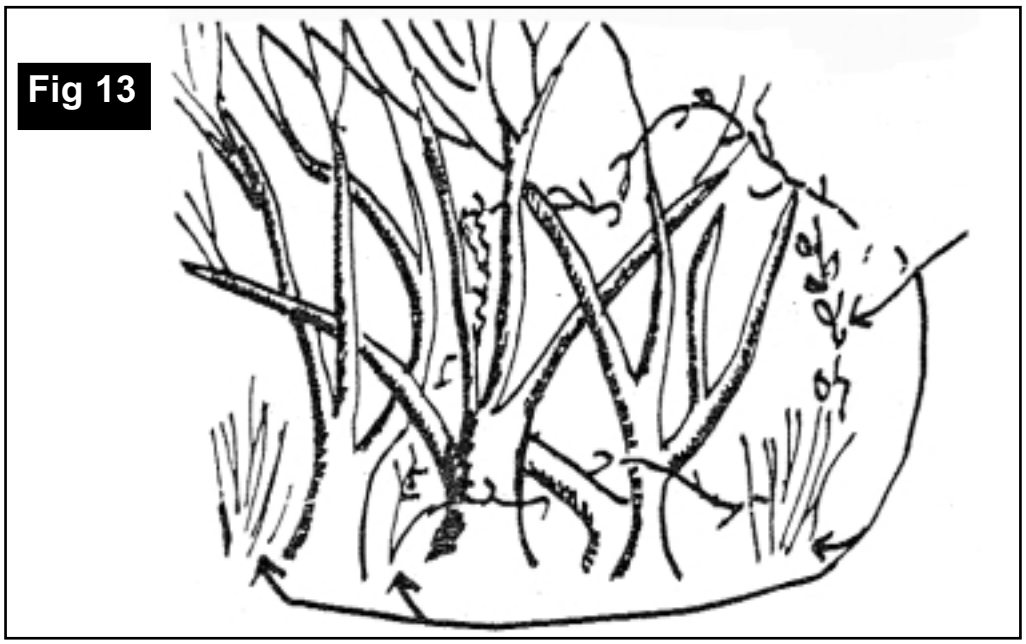
Hake's mouth: If a pleacher is cut with too sharp an angle, it can split back up the trunk, (opening like a fish's mouth), and possibly causing the trunk to rot.

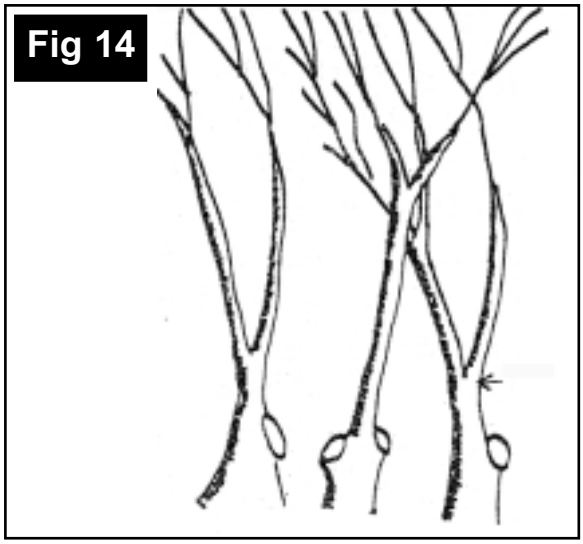
Method

4.1. Decide direction of laying. The general rule is in an uphill direction, but most canal towpaths are on level ground, so lay upstream, i.e. in the direction in which boats would lock up. In summit pounds, lay towards the east or south, to get most benefit from the morning sun.

4.2 Trim away unwanted growth, e.g. suckers or seedlings growing outside line of hedge, heavy bramble cover within hedge.

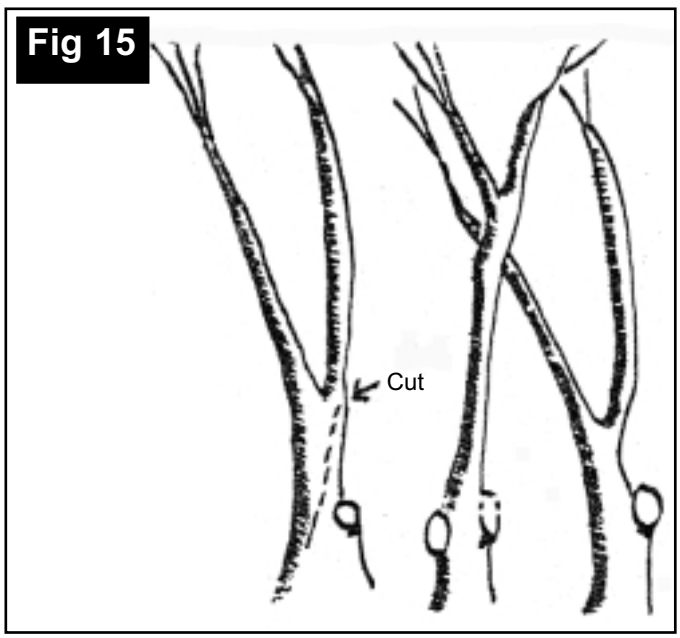
4.3 Cut out any rotten wood, and old pleachers if the hedge has been laid previously. Select the stems most suitable for laying, e.g. the straightest trunks, preferably no more than 15cm. diameter, unless only thicker ones are available. If there is sufficient growth in the hedge, the larger trees may be left as standards if desired. Remove unwanted side growths from those selected (see Figs 13 and 14). Initially, leave more in the hedge than you think you will need, but cut out most twisted and bent trunks, particularly those growing in the opposite direction from that in which you are intending to lay. With a large clump or stool of trunks, it is best to lay those at the front of the clump. As far as possible, any trees or stumps cut out of the hedge prior to laying should be reduced to ground level, as they will interfere with the angle of the new pleachers.

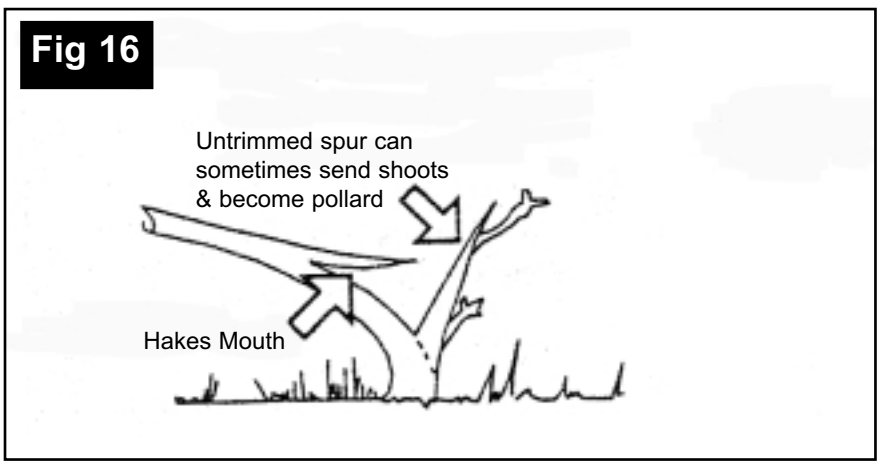




4.4 The pleachers should always be laid using an edge tool, i.e. axe or bill hook, and not with a saw. A saw damages the grain of the wood, and cannot give as smooth a finish, so the scar will take longer to heal. If the trunk is very thick, a chunk can be taken out first with a chain saw, but the cut should always be finished with an edge tool.

4.5 First ensure that the intended pleacher is not caught up or entangled with any other stems or brambles growing in and around the hedge. To lay the stems, make a downward cut on the side that will be uppermost when the pleacher is laid. The cut should be at an angle of up to 45 degrees, cutting 2/3 - 3/4 through the stem - the thicker the trunk, the longer should be the cut - and should finish as near ground level as possible i.e. between 500mm and 1500mm (see Fig 15). The cut should never be at too sharp an angle, otherwise a "hake's mouth" could form (see terms used, and Fig 16).

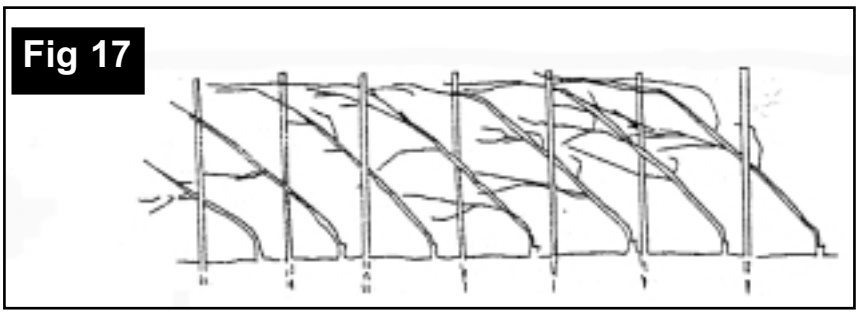




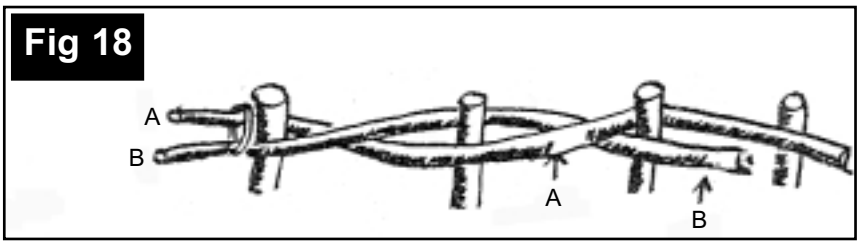
4.6 Gently bend the stem away from the cut, to the required height, usually - 1 metre. Particularly if the pleacher is heavy, it can easily twist round and break off, so it is advisable to obtain help with lowering it into position if in doubt.

4.7 Cut off the projecting stump.

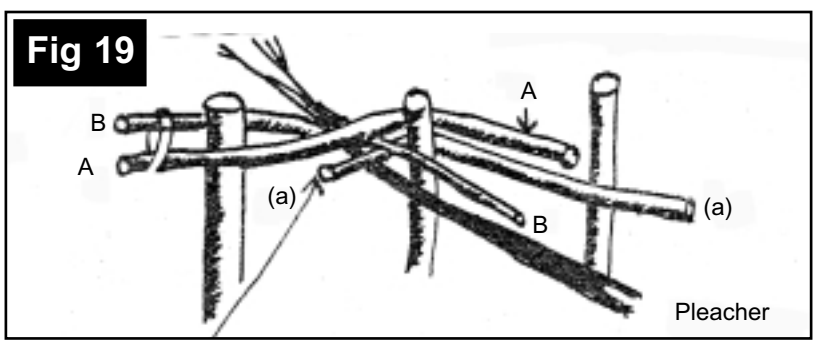
4.8 Stakes can either be driven in before or after the pleacher is laid. If hethering or binding is to be used, the stakes will have to be placed every half metre along the hedge. Trace or weave the pleachers alternately through the stakes (see Fig. 17). Ideally, the brush end of the stem should finish on the field side of the hedge after the pleachers have been woven through the stakes, leaving the towpath side clear for walkers.

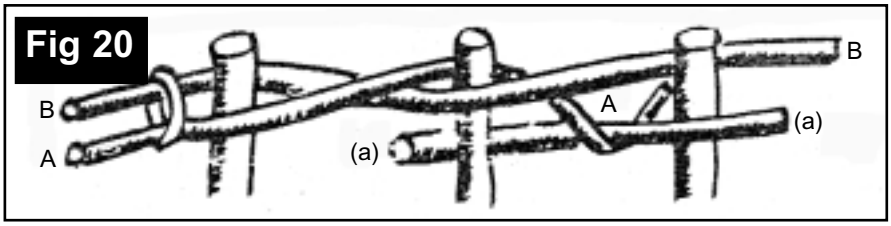


4.9 The use of hethers or binders is optional, but it does help to keep the pleachers in place, and provides a neat, firm finish to the laid hedge. The hethers are long thin hazel, willow or ash stems. Most hedgers anchor the first two binders among the pleachers, or alternatively, the ends can be tied together, as in Fig 18. Bring B over A, behind the second stake, and in front of the third stake. Next bring A over B, behind the third stake and in front of the fourth stake.



Continue these two moves until reaching the end of the hether, when you add a new one as in Fig 19. Put the thick end of the new hether (a) between stake and pleacher, at the back of the hedge. Bring alongside A, and bring both in front of the next stake. Twist A's end round (a) where is will cross under B when B is moved. Push the thin end of A out among the brush. Continue to use (a) as if it were A, and do the same when joining B to (b). (Fig 20).





4.10 Trim the stakes level with the top of the hethering.

4.11 If hethers are not available, the top of the hedge can still be made fairly firm by twisting and weaving the tops of the pleachers together.

4.12 Finally, with a billhook or loppers, trim off any twigs or side branches sticking out, particularly on the towpath side of the hedge.

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Figs 8-12 and 16-17 are taken from Devon Rural Skills Trust Codes of Practice, and Figs 13-15, 18-20 from Hedgelaying Explained by Valerie Greaves, by kind permission from the copyright holders, to whom we are grateful. All other diagrams are hand-drawn by the authors of this chapter.

Practical Restoration Handbook

Bank Protection

by

Dave Wedd

CONTENTS

1. INTRODUCTION

1.1 There are three reasons for bank protection; to give sufficient structural strength to the bank, to protect the bank from erosion (both on the waterline and from the user on the path) and to prevent leaks. The traditional treatment for areas at risk is galvanised steel trench sheeting, more commonly known as piling. It is also known as “campshedding” - from the Dutch “kant schot”.

1.2 Steel piling is currently the most popular form of bank protection but it is not the only method. While it gives a long term structural solution that is appreciated by engineers it has many disadvantages; a high cost per linear metre, strong skilled labour is required to install it, it has low aesthetic value and rarely enhances any heritage project. Whilst the hard vertical side that piling creates may be idea for large boats to cruise and moor alongside, canoeists will find it poor for access and the wave reflections unpleasant to navigate. It is also essential to consider the ecological impacts of any bank protection carried out; a hard vertical bank not only creates a physical hazard by preventing movement between the water and the land but also deprives both flora and fauna of a habitat. The dredging of the bank edge that frequently accompanies piling also threatens the plants and ecosystems that exist in shallow waters. Naturally these problems are increased if both banks are piled.

1.3 It is for this reason that a section has been included on alternatives to steel piling. Some of these ideas have been around for many years but others are new. It is strongly recommended that a good hard look should be taken at the alternative techniques, outlined briefly in Section 14. They often represent a solution to bank protection that is more acceptable to more people and seen as beneficial to both man and beast than cold steel piling. Because many of these ideas have only recently been applied to navigable waterways and each waterway is unique, this is an area that is rapidly evolving. It is therefore well worth discussing your individual project with the manufacturers listed in Section 15.

1.4 However the final choice of which type of bank protection is appropriate (if any) will be arrived at by taking a long term view of expected use together with expert advice (both engineering and ecological). It also cannot be stressed too highly that the need for bank protection can be reduced or eliminated altogether by considering wash and speed control as an integral part of the design of all structures and landscaping of a waterway.

1.5 Note that almost none of these options (including piling) are waterproof without some lining (or cohesive fill material [clay!]) behind them.

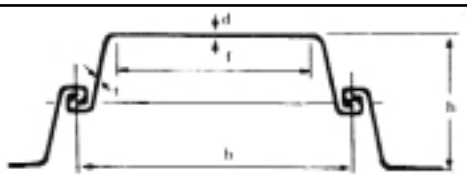
2. PLANNING A PILING PROJECT

2.1 When planning a piling project it is necessary to remember that large numbers of piles are not usually available “off the shelf” and manufacturing will take a few days. Should you wish to have them galvanised (a common procedure for waterway schemes but unusual for most other applications) then this will add a week or so. Piles are also very heavy so transportation and delivery will a) be expensive and b) involve a lot of hauling and humping to get them to where you actually want them rather than where the wagon was willing to drop them off. Pile driving is heavy going and many a strong volunteer has flaked as a result of such a tiring process. Sufficient numbers of volunteers are essential and adequate breaks should be planned into the schedule; this will reduce the possibility of standards slipping as well as avoiding dangerous errors and mistakes. Piling is very difficult to remove and requires specialist equipment - it is best to get it right first time!

2.2 Where the piling forms part of a structure (cills, embankments, etc.) it is essential that the correct design calculations are made to avoid such embarrassing events as slip circle collapse (don't ask - you don't want to know!). These calculations are outside the scope of this document and are the domain of a civil engineer (The IWA's Honorary engineers can also provide assistance - contact via IWA Head Office) however most manufacturers will provide excellent advice and will design basic structures for you, especially if they think you are about to spend a fortune with them. It is important not to deviate from any design without checking with the designer first.

2.3 Piling comes in many sizes and it is the profile that is usually specified. Piles may be so small that a single volunteer can easily lift one into place or they may weigh several tonnes each and require specialist lifting gear. Almost all sizes have been successfully driven by volunteers (even the truly huge Larssen profile) but it is usual for volunteers to work at the smaller end of the market - and it is this technique that this document concentrates on. Although each manufacturer has a different name most profiles are much the same and it is Mabey who are the usually accepted standard for referring to pile profiles. They use M numbers (M11, M8, M7 etc.) to specify the profile and hence the performance specification of each type of pile. They are available galvanised or un-galvanised in various lengths.

LARSSEN



	b mm (nom)	h mm (nom)	d mm	t mm (nom)	f Flat of Pan mm	Sectional Area sq. cm. per metre of wall	Mass kg per linear metre	Mass kg per sq. m. of wall	Combine Moment of Inertia cm4 per metre	Section Modulus cm3 per metre
6W	525	212	7·75	6·4	331	108	44·7	85·1	6459	601
9W	525	260	8·9	6·4	343	124	51·0	97·1	11726	902
12W	525	306	9·0	8·5	343	147	60·4	115·1	18345	1159
16W	525	348	10·5	8·9	341	166	68·3	130·1	27857	1601
20W	525	400	11·3	9·4	333	188	77·3	147·2	40180	2009
25W	525	454	12·1	10·5	317	213	87·9	167·4	56727	2499
32W	525	454	17·0	10·5	317	252	103·6	197·4	73003	3216
GSP3	400	250	13·0	–	271	191	60·0	150·0	16800	1340
GSP4	400	340	15·5	9·7	259	242	76·1	190·2	38737	2279
4A	400	381	15·7	9·6	219	236	74·0	185·1	44916	2360
6	420	440	22·0	14·0	248	370	122·0	290·5	92452	4200

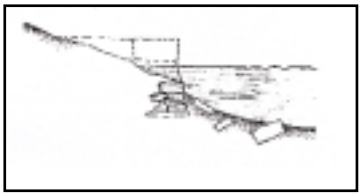
2.4 One firm (Beaver 84) makes a pile that is wider than normal i.e. fewer piles to a linear metre; these obviously will be quicker to drive (assuming that the ground does not present too much resistance) but are, of course, heavier to move around.

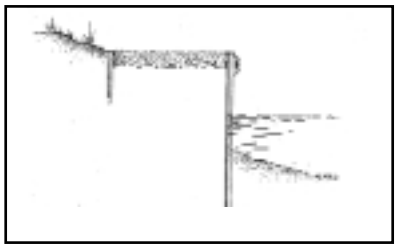
2.5 It is worth remembering that although piling should be a dry, "on land" occupation, British Waterways would never dream of attempting a piling job without at least one set of chest waders.

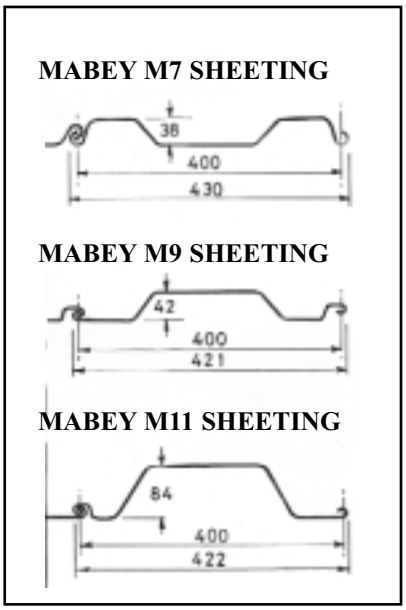
2.6 Where towpath piling is undertaken it is also important to consider safe passage past the works for members of the public. Piling is also incredibly noisy and whilst you may be happy to be on site driving piling at 9.00am on a Sunday your immediate neighbours may not be so pleased.

3. PROCEDURE FOR THE SMALL PROFILE PILES (M11, etc.)

3.1 It is essential with any bank piling to make a gate to hold the piles straight when actually driving them. For M11 piles a gate can be constructed using two railway sleepers and two baulks of 6in x 6in timber of about 7ft minimum length. The railway sleepers should be laid parallel with each other, the thickness of the pile apart, plus about 2mm clearance to stop the pile binding. The baulks of timber should then be bolted on top of, and at right angles to, the railway sleepers. To use the above, you will need at least four strong navvies, or eight weaker ones. For piles with smaller profile than M11, i.e. M7, M8 etc. a gate of lighter construction may be sufficient. One simple technique for a gate is to use two sections of waling (qv) back to back. One end is bolted to the end of the existing run of piling and the other end is held apart using a short anchor pile to provide the appropriate spacing. Fig 1 shows the technique which is much faster than the conventional timber gate.







4. MARKING OUT THE SITE

4.1 Take a very long piece of string, and then insert a stake either vertically in the canal bed, the distance required from the bank, or horizontally in the canal bank. If a bank wall, or similar, previously existed then it may be worthwhile checking and excavating along the line you wish to follow as it is incredibly difficult to pile through even minor debris. It is possible to push the line of piling further into the channel to avoid such rubble but it is important to ensure that you do not encroach too far into the available channel width.

4.2 Tie one end of the string to the stake, and stretch to a similar stake at the end of the length to be piled, or to a convenient length if the string is too short. The run should be as long as possible, or you could get a longer bit of string. (Lasers are no good for this purpose.)

4.3 It helps if the string is at the height required, but this is not essential. (Don't trust a string for the height, as it will bow unless tight enough.) Remember, water is the ideal level and it is seriously recommended that if water is not obtainable at the bottom of the piles then a little excavation is done every 10 piles or so to make it obtainable. Other measurements will accumulate errors, water is flat the world over!

SIMPLE PILING GATE USING TWO WALING STRIPS

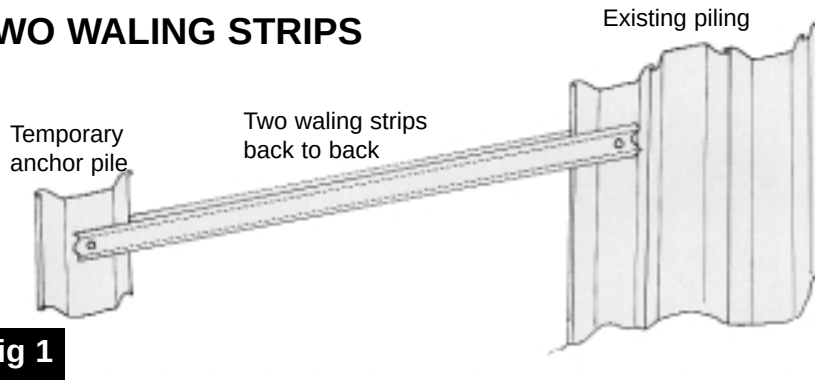
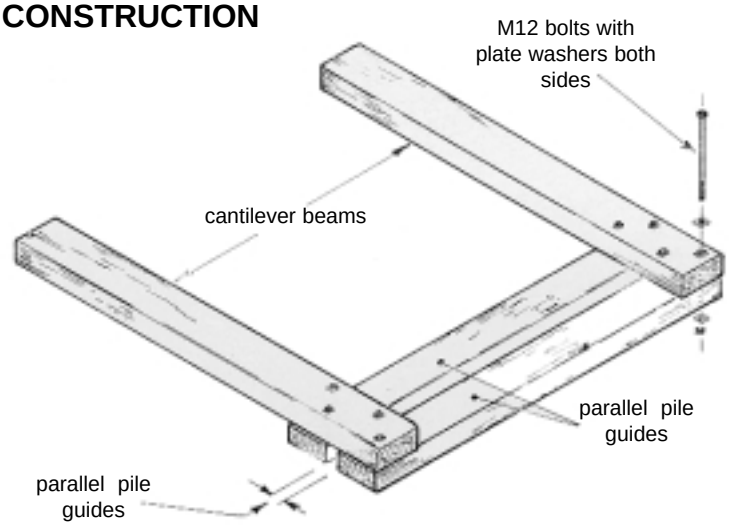


Fig 1

GATE CONSTRUCTION



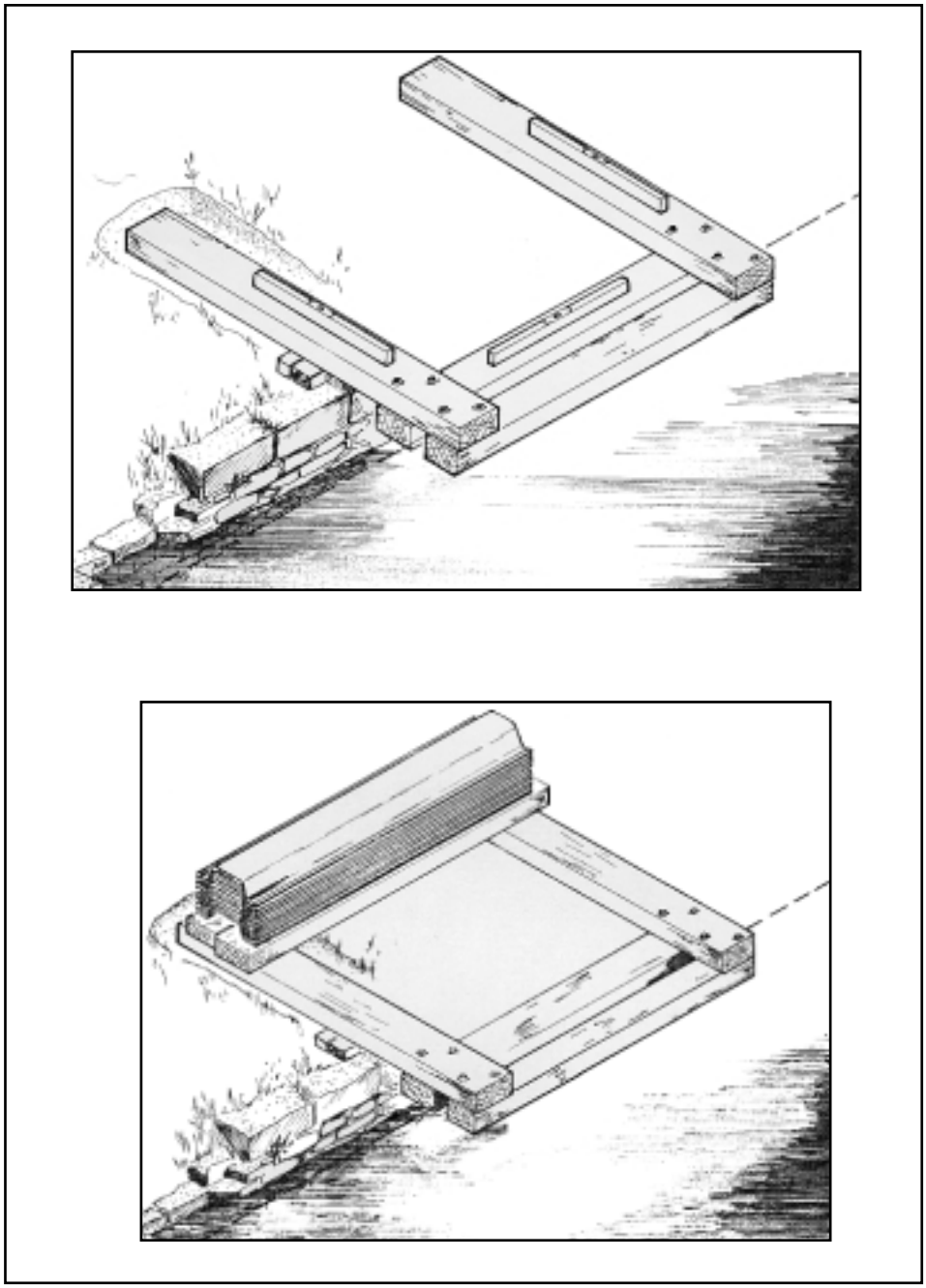
4.4 Lay the gate on the ground with the railway sleepers parallel to the bank. Ease out over the canal until the string is in line with the front edge of the bank-side sleeper. A spirit level should then be used to get the gate horizontal in both planes by means of wedges and chocks. If possible the gate should be set at a lower level than required. If this is impractical, e.g. height of water or bank, then set at about 9in (225mm) above. The final driving to height will then have to be done afterwards.

4.5 Once alignment has been completed, a counter-balance should be placed on the baulks of timber at the back of the gate. This may be made up of a number of piles, or other heavy weights, sufficient to stop the gate moving when holding a piling gun and standing on the bit over the canal.

5. LOADING THE GATE

5.1 Take the first pile and place it in the gate with the hole at the top, and, in all cases, with the hole nearest the canal so that the waling (edging) can be bolted tight to it. Using the spirit level set the pile dead vertical in both planes.

5.2 To keep it vertical use wedges between the pile and the sleepers and waste pieces of timber nailed across the slot in the sleepers tight against each end of the pile. Place cap and piling gun on top of the pile and



drive two or three inches (50-75mm). An alternative to the wedge technique is the use of “lorry” style ratchet straps. These can be attached to the pile that is being driven (using the hole in the pile) and once the other end is attached to an immovable object (the gate, say) the ratchet can be adjusted to provide just the right amount of tension in the appropriate direction. It is obviously essential that both ends of the strap are fixed securely.

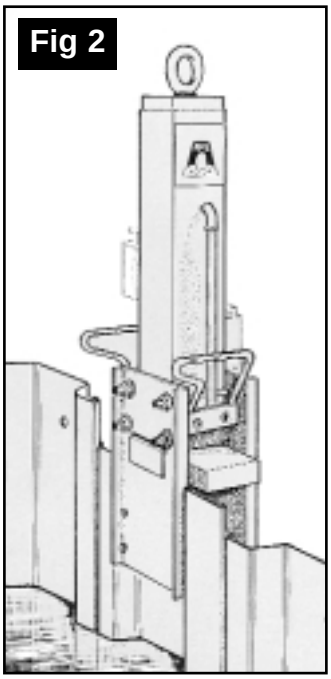
5.3 Check again for vertical in both planes. If it has altered use strong bodies or levers to push in the appropriate direction and drive another two or three inches (50-75mm).

5.4 Continue this procedure until you have driven about a foot (300mm). If you can’t get it right on this one, pull it out and start again - there may be a stone underneath. The authors at this stage would like to point out that it is not advisable to have a swear box on this job as you won’t have any beer money left at the end of the day!

5.5 Having got the first pile correctly driven down to the correct level, remove the nailed waste timber, and load enough piles to fill the gate, if you are able to safely reach this height. Ensure that the clutches (the curled bits on the side of each pile) are slotted together.

5.6 Note that the hole should be at the top of each pile, in case you need to pull it out, but with some types of pile the hole may be at the back of the piling on alternate piles.

5.7 Before being driven, each pile should be made vertical by means of wedges and/or pushing. It is usually most successful to drive the last pile in the gate first (i.e. the one furthest away from the existing run of piles) as once this is in vertical it limits the tendency of the others to lean. When the full gate has been driven to height, the gate counter-weights should be taken off, and the gate re-positioned ensuring again that the gate is level in all planes.



5.8 The clutch of the last driven pile should be visible in the slot of the gate to ensure that the clutch of the next pile to be driven can be engaged. Repeat procedure as before.

5.9 All piles should be checked for vertical after they have been driven two or three inches (50-75 mm) and any corrections made as described above. When the length has been driven, remove gate and, if piles have not been driven to the final level, this can now be done without using the gate.

5.10 You may need to use planks to stand on to do this safely. This stage should be done with care, because a piling gun is very heavy to get out of the water after you and it have fallen in! Piling guns also cost a lot of money.

5.11 Lucky navvies who do this job sometimes find a dry canal to do it in. You can then use quick-erect scaffold towers in the canal bed to assist in loading the gate. You may even be able to dispense with the cantilevered gate, by laying the sleepers (or just scaffold boards) on the bed of the canal, and holding them in place with stakes. This will control the position of the toe of the pile, but you may find it difficult to find a safe way to control the angle at the top, without having someone standing underneath the piling gun, which could obviously be very dangerous.

5.12 Note that piles will usually tend to lean forwards along the line, so it may be an advantage to start by leaning slightly the other way. As a special case of Sod's Law, you may then find that the slope gets progressively worse that way instead!

5.13 If the piles are starting progressively to lean along the line, you may be able to recover the situation by loading the gate and driving the last pile first, and then working backwards, to finish with the pile nearest to the leaning ones. You will have to produce a kink in order to remove a large error, so don't let errors get large! You will soon get a feel for exactly how the pile responds to the friction of a pile's clutch on

one or both sides. It is also unlikely that your piling hammer will strike the piling cap, and hence the pile, evenly and so this will also promote any lean that is occurring.

5.14 When using the spirit level, make sure you don't hold it across irregularities in the pile, such as curled tops, or blobs of galvanizing. If piles will not drive to level, then the top will have to be cut off.

5.15 It can not be emphasized too much that it is essential regularly to check the "big picture" i.e. to stop and walk back to the start of the run and look along the whole length to check you are still heading in the direction you want to !

6. TURNING THE BENDS

6.1 This will need to be a series of straight lines, (unless some idiot (sorry, genius) wants to make a curved gate!) Bear in mind that piling usually attracts boats, which require a straight length equal to that of the boat to moor to.

6.2 First mark the curve using string and as many stakes as required to obtain an even curve. Set the gate in line with the string as before, using as many piles as will match the string.

6.3 The gate does not necessarily have to be filled, but it will be seen that the easiest curve will be one that uses a series of straight lines, each equal to the length of the gate. For sharp bends you will need to put a pile in freehand, and drive to depth, then set up the gate as normal for the next straight section. An alternative technique is to anchor a piece of string in the bank and use it to "draw" a radius for you to follow.

7. ENDING THE RUN

7.1 The last two or three piles should be turned in towards the bank to reduce erosion from breaking wash reaching the end of the run of piles, unless there are plans to continue the length at a later date. When turning into the bank the ground is likely to be harder, so it may be necessary to use one or two shorter piles (cut with a Stihl radial saw with metal cutting disc).

8. TIE BARS

8.1 Tie bars go through the hole in the pile and through the waling and back to an anchor point in the bank. They consist of a length of 20mm dia. mild steel bar which is threaded at each end. Nuts and washers usually come with the tie bars. The anchor point is usually a piece of pile about 1 metre long (with a hole in the top), depending on the ground it is going into.

8.2 Anchor points are required every 5 piles or so. The exact spacing is determined by the spacing of the holes in the waling and it is usual for every other hole in the waling to be used for a tie bar, with the remainder simply being filled with a nut, washer and bolt. The anchor piles are driven into the bank at a distance slightly less than the tie bar, to allow for the nuts, washers and the thickness of the waling.

8.3 The anchor point should not be vertical, but angled slightly back from the canal, and its top should be about an inch below that of the pile. This may require some work with a mattock and shovel so that the tie bar can lie correctly without being bowed. It will probably be necessary to remove earth when the anchor is at ground level to allow piling equipment to drive it to level, and also for a hole to be dug to allow access to the hole in the anchor to put the nut on the end of the tie bar.

8.4 It is unusual to tie back M11 piles of more than 2 metres in length, as they are intended to be self-supporting if the ground is reasonably firm.

9. WALING AND CAPPING

9.1 The waling is the piece of hardwood timber or steel that is bolted to the front of the piling to protect both piling and boats, and also to add rigidity to the piling. Although the act of fitting this waling will pull in minor bulges and even out curves do not expect it to work miracles - get the job right in the first place. The capping, if fitted, is a piece of timber that is usually nailed on top of the waling and resting across the top of the piles. This is mainly decorative, and, of course, is only fitted with timber waling.

9.2 Note that metal waling is designed to overlap and it is best to guess the main direction of boat traffic and ensure the overlap is set to minimise any damage to a boat travelling in that direction. Waling can be "pulled in" round gradual corners using the tie rods but sharper corners will require partial cutting through of the waling and then bending round a tree stump or similar.

10. BACK FILLING

10.1 If piling has been carried out on an embankment, or where the ground is about the same level as the canal, then the gap between the piles and bank should be filled with clay if possible to make it as water-tight as possible. Clay should be free from rubble and other contaminants, it is also considerably easier to work with in dry powder form but this will depend on your supplier. If piling is at the foot of a bank, the back-fill should be of rubble or similar (so that the bank can drain in wet weather) and the top 2 or 3 inches filled with ordinary soil. If the holes in the piling are more than about 3 inches above water level, then drainage holes about 2 inches dia. should be cut in the piles just above water level and about 6 feet apart. Back filling will settle and the project plan should allow for a return visit some months later to refill and landscape. If the fill is dangerous (i.e. deep mud) then it should be fenced off and signed as dangerous.

11. PLASTIC PILING

11.1 This has been a new development and British Waterways and Environment Agency have experimented quite extensively; they found it did not meet their normal requirements - it was difficult to drive and not "boat proof" enough. However, it is recognised that its many advantages; lighter, 100% recycled, longer lasting, cheaper and quieter to drive mean that once it works it will be a very popular technique. And it will be available in a range of colours ! At the time of writing one firm (H L Plastics) claim to have cracked the drawbacks of plastic, working in conjunction with Aldridge Piling equipment (APE) to develop a hammer that drives them. They are based in Derby.

11.2 Wooden piling is also a possibility (particularly in high saline canals where corrosion is a worry) but it is very difficult to drive.

12. SAFETY

12.1
- Make absolutely certain there are no electricity cables or other buried services in the line of the piling.
- Take very great care to properly assess the Piling operation with regard to Lifting and Handling. Excessive reaching with heavy loads is a particular risk.
- **EAR DEFENDERS MUST BE WORN AT ALL TIMES WHEN ACTUALLY DRIVING PILES.** This still applies when the gun has a muffler, or silencer built-in. Goggles are also recommended.
- When piling, the gun will slide around on the cap. This must be steadied by holding the gun itself. Do not hold the yoke in the end of the gun, and do not steady it by putting your foot on the cap, as yoke shafts occasionally break owing to metal fatigue.
- Wear steel toe-caps as piles and the equipment are heavy and toes are easily broken, and limping navvies are not so effective.
- To avoid accidentally pressing the trigger, keep fingers under the lever, or well away from it, when moving the gun.
- Wear gloves to prevent white finger. Piles are also notorious for having sharp edges and lumps of galvanising. They are also very cold for most of the year.
- Take care not to over-reach yourself when loading the piles into the gate.
- Ensure air has been isolated and released before changing/fitting yokes.
- If flame or other form of heat is used for cutting galvanised piles, beware of fumes. **ZINC (GALVANISING) PRODUCES HIGHLY TOXIC FUMES AND CAN BE VERY DANGEROUS.**

13. EQUIPMENT

13.1
- One air compressor of not less than 100 c.f.m. (cubic feet per minute)
- Air hoses to suit distance required.
- Piling caps and yokes (also known as dollies and shoes). (Can be hired from Mabey's, who have depots throughout the country.)
- Air hammers (jack hammers) (may have silencers built-in).
- Gate, as described above.
- Assortment of putlogs and crowbars, and sledge hammers.
- Lubricant for the air hammer (usually hydraulic oil possible including antifreeze in cold weather.

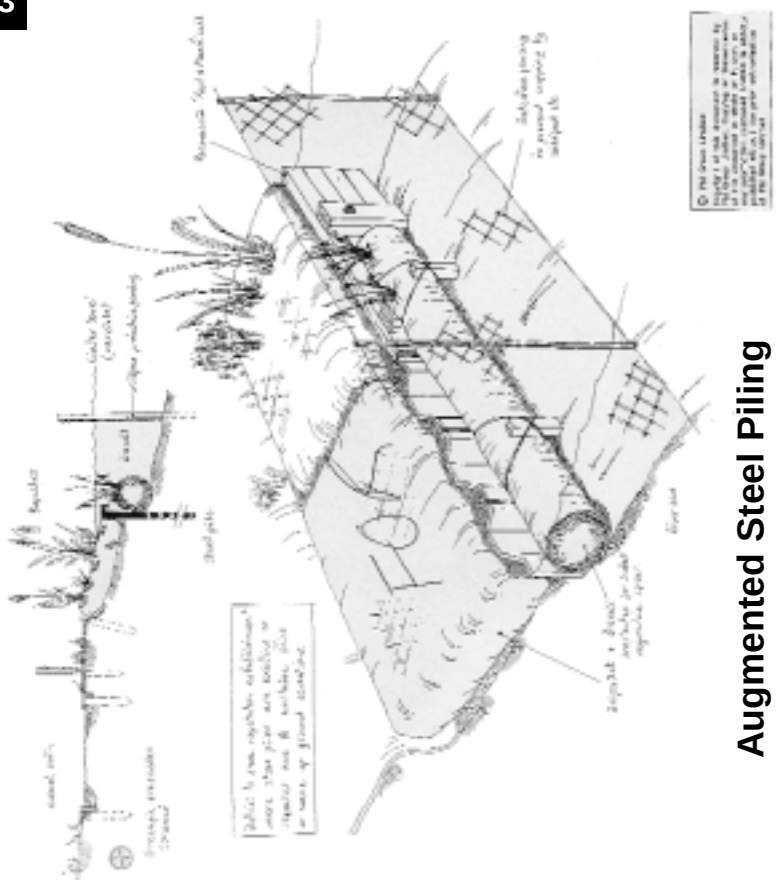
13.2 If work is taking place in the Midlands, Aldridge Piling Equipment hire out a very good 2 cwt piling gun which obviates the need for piling caps, yokes, and jack hammers, as it clamps itself to the top of the pile. This hammer is highly recommended by most WRG groups as the safest and most effective machine around. An illustration is given in Fig 2 - page 9.

13.3 It has a handle either side for carrying and guidance, and a lifting eye at the top. This would ideally be lifted by a small crane or excavator, but a useful substitute is a scaffold pole as a lever, with the fulcrum on the roof of a narrowboat. If using this, you will require 5 strong slaves, as it gets heavy after a while. Ear defenders are essential when preparing a meal in the galley!

14. ALTERNATIVES

14.1 The suitability of these techniques depends on the requirements of the project. Factors such as bank slope angle, drainage requirements, access, erosion, aesthetic and environmental requirements, current and future possible use should all be carefully considered. It must be stressed that one big advantage of many of these techniques over traditional piling is that they permit a more ecologically acceptable solution to the problem of bank protection. Careful use of the techniques described here can result in a system of bank protection that does not harm the existing bio-diversity and can actually promote it. This is particularly relevant in the light of recent legislation (e.g. water voles joining the protected species listing). Each technique has strengths and weaknesses depending on what type of flora or fauna you are trying to encourage. "Pre-seeded" versions of many of the techniques discussed below exist but very careful thought should be given as to whether they are appropriate or desirable. They may well harm the bio-diversity that we are trying to protect and enhance in the first place. In particular alternative techniques should be considered where existing conventional bank protection needs to be enhanced or repaired. Figure 3 (below) shows how steel piling can be augmented and "greened up" by new techniques. One new development being used extensively by British Waterways on the Montgomery restoration is to excavate the bank down to near waterline, pile along the bank to just above the waterline and then replace the bank so that the piling is completely buried in the bank. This gives somewhere for the wildlife to live

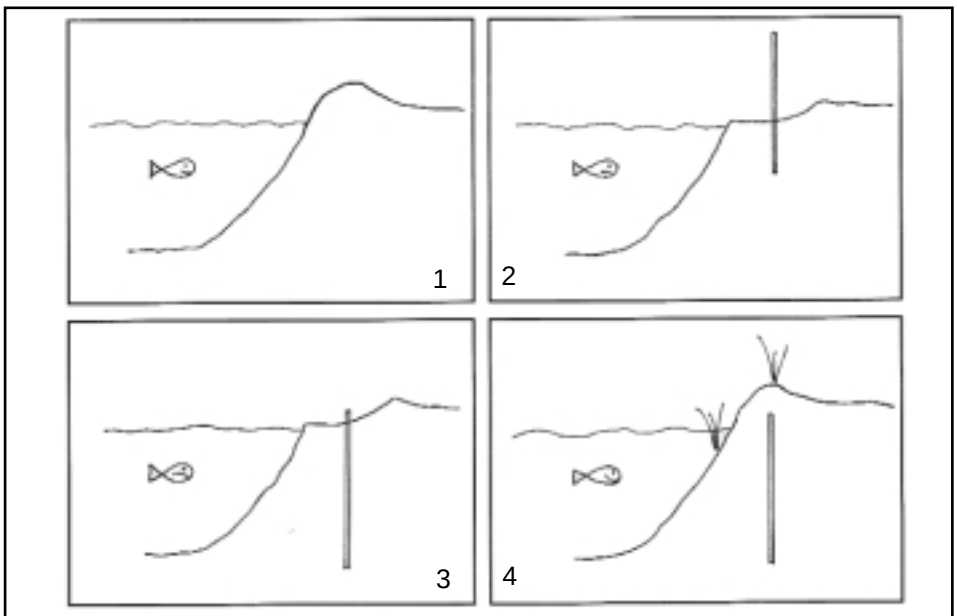
Fig 3



Augmented Steel Piling

yet still offers many of the engineering advantages of "proper piling". Aesthetically it is a vast improvement on the steel lined channels so many engineers insist on to minimise maintenance costs and water losses. It also does not encroach on channel width. However it does create a buried hazard and so it is particularly suited to protection of the offside bank. Figure 4 illustrates the sequence. It cannot be stressed too highly that for all techniques involving the construction of a wall or similar (gabions, blocks, bricks, etc.) it is the preparation before the installation that determines the long term success of the construction. For a neat, structural, regular bank edge it is essential that the base upon which the blocks are laid to be well prepared.

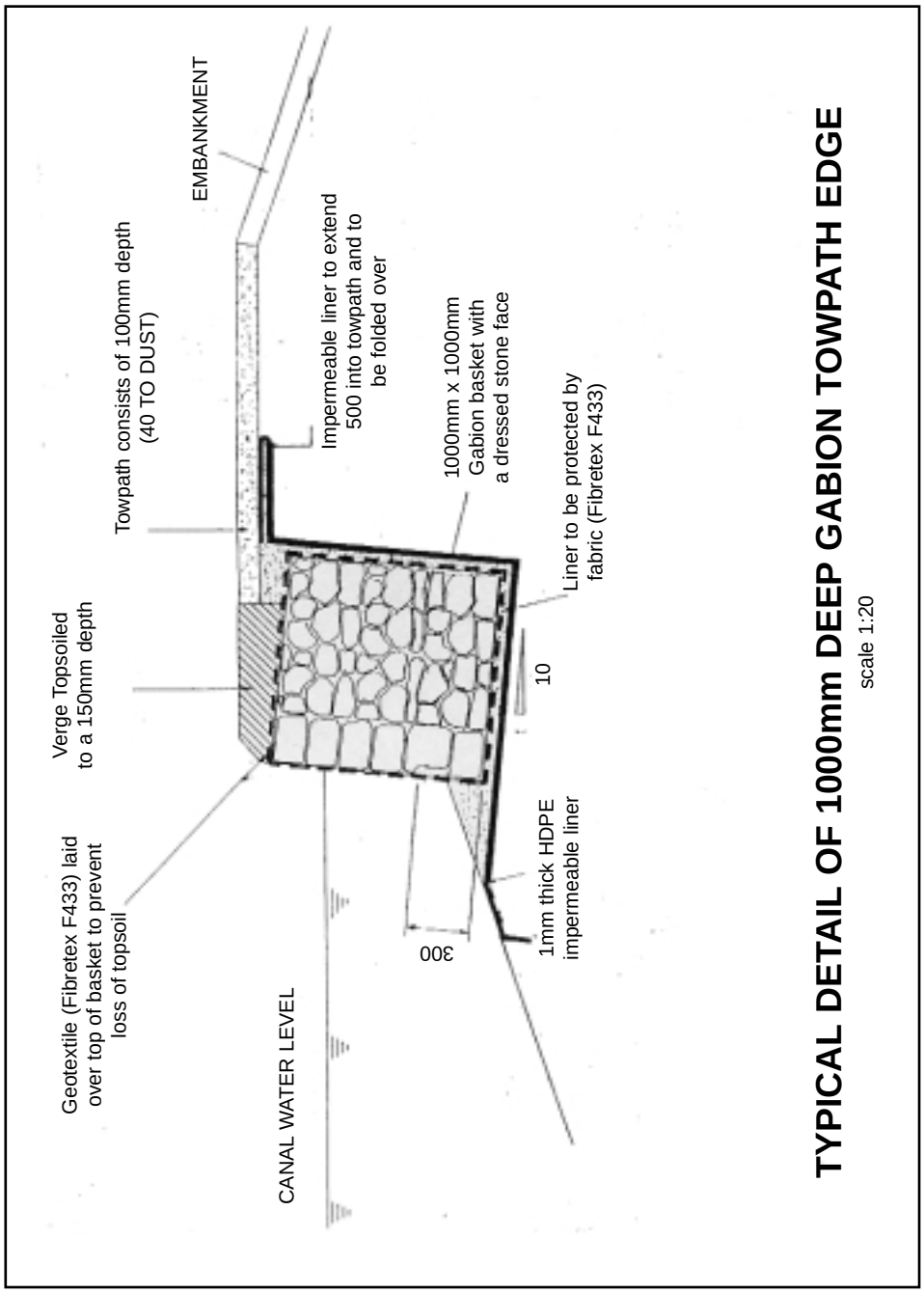
14.2 **Gabions:** These are simple wire baskets, supplied as a "flat pack". They are wired together and filled with a stone/earth mix in situ. They are simple to install, effective and, if appropriately designed, green but are labour intensive. Costs depends on fill material which can be selected to be most appropriate to the site concerned. They can be installed with water in the channel but it is certainly recommended that the level is significantly lowered. They are a long term solution as the bank and vegetation grow around it but they are poor for moorings as pins cannot be easily driven. The wire will eventually corrode away and it is essential that vegetation is established before this happens. However this corrosion may well take 50 years or so. Neat laying of stone will minimise collapse when the wire does eventually corrode away. Very flexible as many shapes can be made up from basic boxes. For very hostile environments the wire can be galvanised or even PVC coated. (See Fig. 5, page 15, shows a typical installation specification, note that the gabions are used to hold down a waterproofing liner - a common technique).



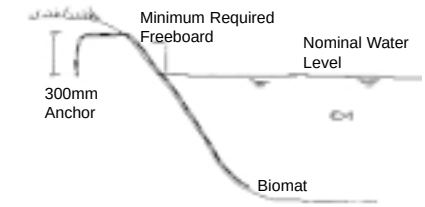
BURIED BANK PILING

14.3 **Biomats:** More properly known as ECRM (Erosion Control Revegetation Materials). These are geotextiles with a very loose weave designed to hold earth and promote vegetation growth. They exist in many different forms and designs. Easy to install (but big rolls mean mechanised handling may be required) but no real strength - it is an erosion prevention technique. It requires at least one growing season without wash to green up and so is not an instant solution. They come in a very wide range of duties from lightweight to very heavy weight. The same technique exists as "rolls" and "mattresses" (they tend to compress down and settle over six months or so, so it is best to order extra). Not green if "preseeded biomat" is used as it will introduce non indigenous species. It can however follow any curve you want and so is the least visible of all the solutions. Some versions are constructed using jute or similar

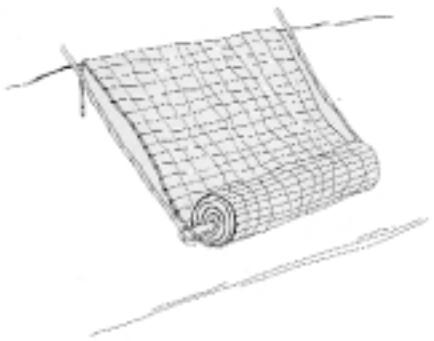
and are designed for the initial mat to decompose over several years leaving only the established vegetation. They are good if installed during a restoration as they actually catch silt and sediment stirred up by other restoration works; this helps build up the bank and keeps the water quality up (see fig 6, page 16). Note that some versions (especially the preseeded types) do require immersion in water within 24 hours of delivery and, once installed, need to be kept covered by approx. 100mm of water for the first growing season. This may present initial handling problems and prevent other restoration works occurring on sections where they are planted for the first few months after installation.



14.4 **Armater:** this technique has the same features as Biomat but requires manual filling of its many hexagonal pockets (usually with soil/seed mix but sometimes a lean mix of concrete is placed first to partially fill each pocket) (also known as honeycomb geotextile).



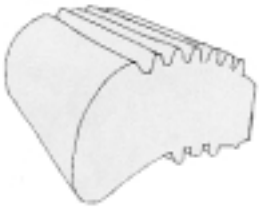
Completed Biomat Installation



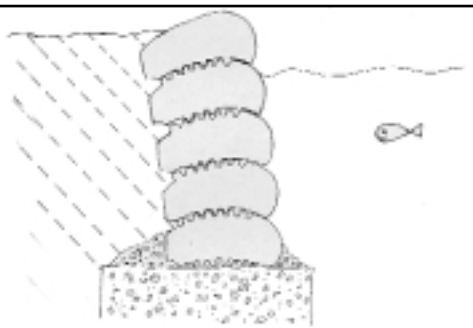
Biomat Installation

Fig 6

Fig 7



Porcupine Block



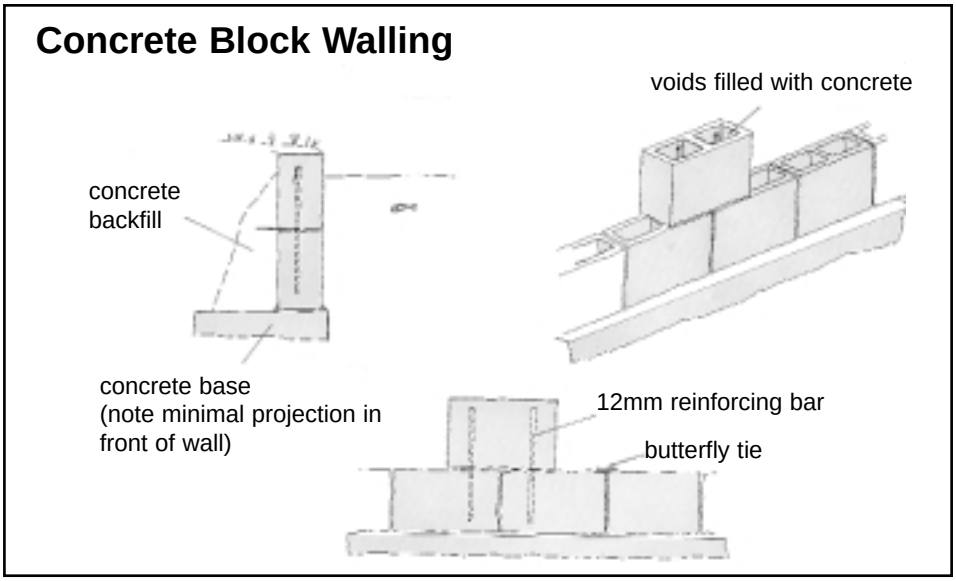
Completed "Porky" Block Wall

14.5 **Porcupine blocks:** ingenious engineering make these spined blocks very flexible and easy to install by unskilled labour, they can be angled back to suit the bank (7.5-22.5 degrees from vertical) and can form curves (3m min. radius). They are however heavy (26kg each!) and they must be placed on a firm level base (which usually means the expense and inconvenience of draining down and laying concrete). Quite expensive but moderately green as holes can be left for animals and vegetation. Aesthetic appearance is acceptable after a year or two of weathering. Many other versions of this type of "modular construction system" exist but "Porky blocks" seem to be the market leader (see fig 7).

14.6 **Sandbagging:** this is an old fashioned technique but can still be effective although its appearance is not the most desirable. Bags can be filled with either concrete (structural solution) or soil (environmental solution). It has significant mass and so can be structural but only if it has a firm and stable base.

14.7 **Concrete blocks:** closely allied to the sandbagging technique and a dear favourite of early works on the Stratford Canals. The hollow blocks are laid as brick bond and reinforcing rod is placed vertically through the perforations in the block. Wet concrete is then poured into the gaps. It is also usual to backfill with concrete. Where it cannot be seen this is an acceptable (and fast) technique but again it requires a structural base; however where a durable vertical wall is required it is a solution. It is also intrinsically waterproof once backfilled.

14.8 **Brickwork:** is, of course, a preferred option to concrete blocks on aesthetic grounds (it is also better for long term maintenance reasons). But it too requires a firm base and is the most skilled type of bank protection. It is also waterproof once backfilled.



14.9 **Stone walling:** this may be an appropriate local solution. For further details see IWA Practical Restoration Handbook "Towpath Construction".

14.10 **Willow screens ("revetments") and other such olde worlde stuff:** there is still a place for these techniques, particularly in this overengineered world that the navigation authorities seem to want us to inhabit. For further information Chaplin has a lot of ideas and this book is recommended as further reading. Phi Group Ltd also have considerable experience in the "revetment" field.

14.11 **Waterproof lining:** although not strictly bank protection this may well need to be considered as even seemingly solid banks with no need for conventional bank protection can be eroded by a leak causing a costly and inconvenient breach. The two main options are the traditional puddle clay - machine intensive for large expanses and reliant on materials being available, but very suitable for small patches installed manually by volunteers. Two tips - firstly; always dig out more than you think you need i.e. until you can be absolutely sure that you have reached continuous existing puddle and secondly; work the new clay very well (known as punning) either by excavator bucket or by good old fashioned puddling boots. The second main option is a flexible liner. Butyl Rubber (usually 1mm) is used for maximum flexibility whereas cheaper but more rigid High Density Polyethelene (HDPE - 2.5mm) is used for straighter, simpler runs. They are produced in sheets up to 15m wide and if a longer run is required they are welded together in-situ using an electric "waffle iron". Both types need to be installed in clean, dry conditions and while it has been proven that volunteers can install flexible liners (Aston Nature Reserve is entirely lined in Butyl Rubber) it is often installed by professionals. The liners can be keyed into existing and new structures but this must be designed by a competent designer. Liners also need protection from boat collisions, boat poles, herons, voles, fisherman, etc.

15. SUPPLIERS (listed in alphabetical order):

Hire/supply of piling equipment:

Aldridge Piling Equipment (Hire) Co. Ltd.,
Conduit Road,
Conduit Industrial Estate,
Norton Canes,
Staffordshire.
Tel: 01543 277680

Suppliers of steel trench sheeting:

British Steel Narrow Strip (Offices all over the country),
Ayrton Steel Products,
Whitehead Works,
Mendalgief Road,
Newport,
Gwent.
NP7 2WX
Tel: 01633 244000

Beaver 84 Ltd (Offices all over the country)
Beaver House
Crompton Close
Basildon
Essex
SS14 3AY
Tel: 01268 530888

Mabey Ltd. (Offices all over the country)
Head Office
1 Railway Street
Scout Hill
Ravensthorpe
Dewsbury
W. Yorks.
WF13 3EJ
Tel: 01924 460601

SGB Groundforce (Offices all over the country)
Dolphin House
Windmill Road
Sunbury on Thames
TW16 7HT

Suppliers of alternative products

Butyl Products - Waterproof liners (including installation)
11 Radford Crescent
Billericay
Essex
CM12 0DW
Tel: 01277 653281

HL Plastics - Plastic piles
Duffield Road Industrial Estate
Little Eaton
Derby
DE21 5EH
Tel: 01332 832389

Maccaferri-Gabions, ECRM, Geotextiles etc.
7400 The Quorum
Oxford Business Park North
Garsington Road
Oxford
OX4 2JZ
Tel: 01865 770555

MMG - Porcupine blocks, ECRM, Geotextiles, etc.
St Germans
Kings Lynn
Norfolk
PE34 3ES
Tel: 01553 617791

Phi Group - Gabions, ECRM, Modular Construction Systems, Geotex, etc.
Harcourt House
Royal Crescent
Cheltenham
Glos.
GL50 3DA
Tel: 01242 510199
www.phigroup.co.uk

16. FURTHER READING

Any or all of the above manufacturers' free catalogues and guides. In particular Maccaferri, MMG and Phi Group produce excellent literature (including installation guides) and are very helpful.

"Waterway Conservation" Peter H. Chaplin published by Whittet Books ISBN 0-905483-72-3.
"Waterway Architecture - an economic return from conservation" Inland Waterways Amenity Advisory Council, 1985.

Illustrations by Keith Wilcox and Mike Palmer.

IWA "Towing Path Policy Document" and
"Towpath Construction" - IWA Restoration Handbook
Inland Waterways Association
3 Norfolk Court
Norfolk Road
Rickmansworth
WD3 1LT

Practical Restoration Handbook

Excavators
– Safe Operation in Canal Restoration

by

Spencer Collins

CONTENTS

1. INTRODUCTION

1.1 Excavators come in different sizes from 1.5 tonnes to 50 tonnes, may be tracked or wheeled, and capable, in the case of a river rig, of a reach of approx. 18 metres (60 feet). They may also be required to lift a load of several tonnes on site. Too small a machine and you will be over-reaching the capacity – dangerous. Too large a machine and a lot of trees on the towpath will have to be removed or they will get damaged. There is no point in having a machine that can reach the other bank if you can't get it into position. It is, therefore, very important that the correct size of machine is selected for the job intended.

JCB JS220 Long Reach

Excavators come in all sizes!

1.2 You are totally in charge of the machine. It doesn't matter who has told you to do something with it, if you are not happy to do it for whatever reason **do not do it**.

1.3 Please note that this chapter is primarily concerned with the safe use of excavators and therefore does not fully cover many of the items associated with **excavations**. The relevant legislation for excavations is the "Construction (Health, Safety and Welfare) Regulations 1996". The relevant regulations are 12 & 13 and these state that steps should be taken to:

- prevent collapse of ground both in and above excavations
- identify and prevent risk from underground cables and services

Additionally,

- from the outset, and as any work progresses, any excavation which has the potential to collapse unless supported, should have suitable equipment immediately available to provide such support.

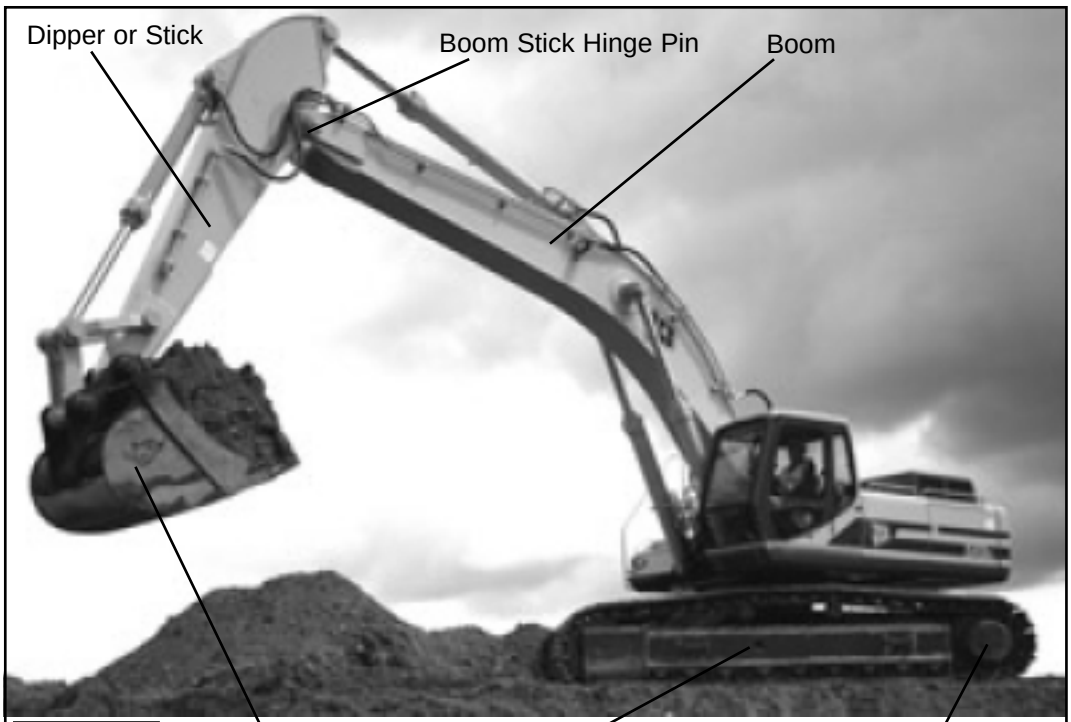
1.4 It is recommended that the reader obtains a copy of the Construction (Health, Safety and Welfare) Regulations 1996 (available from HSE).

1.5 Equally, work in confined spaces is not covered. See "Safe Work in Confined Spaces" HSE L101.

1.6 Good results when using an excavator can only come with practice. Achieving competent results in trenching, grading and landscaping requires considerable experience and is outside the range of this chapter. Therefore the text concerns itself with safe operation and gives best practice techniques. Regular practice, using these techniques, will result in the ability to excavate regular holes and finish off attractive banks in a safe and efficient manner – practice makes perfect.

2. PARTS OF AN EXCAVATOR

Please note that a wide variety of terms exist for parts of an excavator depending on manufacturer and use. In particular the term "stick", which is the authors preferred term, is frequently referred to as "dipper". Both are acceptable.



Principle Parts of an Excavator

3. BEFORE STARTING WORK

3.1 Do a good site survey in advance checking for:

- Overhead power lines, cables and other height limitations in the working area of the machine or on the route from the storage compound. If lines are present then see later chapter on working near overhead cables

- Underground services such as gas pipes, water pipes, sewer pipes, electric cables, telephone, cable TV, land drains, culverts, ducting and plug holes! All of the utility companies will provide a map of the location of their services if any are on site. Many services are now being laid under towpaths. See later chapter dealing with underground services.

- Ground conditions where the machine could get bogged down or worse. Will they deteriorate significantly if it rains? A common accident is where a machine rolls or falls into the excavation it is digging. Where possible plan the work to avoid poor ground conditions. Perhaps a long carriage machine (LC) or "bogtracks" will be needed.
- Will the excavation reveal or release toxic liquids or gases that will pose a risk to anyone either in the excavation or nearby? Will special arrangements need to be made for disposal of the spoil (see PRH "Health and Safety Section 4 – Control of Substances Hazardous to Health").
- Is the site accessible to the public?
- Consider the room required for manoeuvring the machine. Consider width restrictions and egress and whether there is room to slew and gain access.
- Confirm with the site manager exactly what the job entails.
- Refer to the Site Health and Safety Plan for additional information regarding known site hazards. Should you discover an unknown hazard (either temporary or permanent) it should be reported to the Site Leader for assessment and possible inclusion in the Plan.

3.2 This survey enables you to select the correct type of machine if one is being hired in, to arrange mats for the machine to sit on if soft ground is present and to arrange additional extras such as safety fencing.

3.3 The job should be fully planned out before work starts, right up to and including the excavator leaving site. Access and egress should be considered and the excavations should be in a safe condition at all times.

4. TRACKS VERSUS WHEELS

Tracks	Wheels
Less ground pressure	Mobility and speed (21mph versus 3.4mph)
Traction	No pavement damage
Manoeuvrability	Increased stability with blade and outriggers
Faster repositioning	Levelling of the machine with outriggers
No punctures	Dozing capability on a large machine

4.1 Unless the job requires a lot of travel to, from and around site, a tracked excavator is better for working on canals. A further consideration is whether to have rubber tracks or steel tracks. Generally steel tracks are better for "real" sites, unless you intend to use the machine on tarmac, brick paving, etc. where rubber will leave far less mess.

5. CHECKS

5.1 All the specifications, controls and checks for different makes of machine vary slightly. **Please read and understand the operators manual for that machine**.

5.2 Please note that if you hire in a machine with a driver/operator then you are technically employing him and therefore need employees insurance liability. If you are a participating member of the IWA insurance policy then you may or may not have this cover – it is not automatically included. Make sure you sort this out with the IWA Insurance Officer and the Hire Company before you start work.

5.3 If the machine is owned by the Canal Society or Trust then it is strongly recommended that the overall maintenance and care is delegated to one man, other volunteers may work on it, but it should all be under the control of one person. This means that long term problems can be tracked. Whatever system of maintenance and servicing is employed by an individual, company or society, the operator has the responsibility for ensuring that the equipment is in a safe condition **before** they operate it.

5.4 Daily maintenance and checks:

- Tyres, inflation, wear and any damage
- Tracks for correct tension that all the track pins are in and nothing is stuck in the tracks
- Fluid levels, engine oil, coolant, hydraulic oil and fuel – see operator's manual
- Hinge pins in the arm and bucket are in and locked in position
- Teeth on the bucket are tight
- Lubrication of pivot grease nipples and slewing ring as per recommendations in operation manual
- Overall inspection for fluid leaks, damage, cracks and interference from public
- Clean windows and mirrors to aid visibility
- If the machine has strip-down security shields then keep all parts together

5.5 These checks do take time and are tedious but it is much better to find out problems when in the yard than when in a sea of mud on site.

5.6 Be careful when checking over the machine, surfaces can be slippery due to spilt diesel, oil and frost. Always keep your boots and gloves clean.

5.7 Used diesel oil is carcinogenic so never wipe the dipstick on your clothes (this also avoids getting it on the seat). Use a cloth. Do not put it in your pocket, dispose of it.

6. INJECTION INJURIES

6.1 If you suspect a hydraulic line is leaking never run your hand along the hose to find the leak with the engine running. There is sufficient pressure through a small hole (100psi or above) to inject hydraulic fluid into you. Immediate attention must be sought if this occurs. Failure to do so will result in gangrene and blood poisoning after 24 hours.

7. PERSONAL PROTECTIVE EQUIPMENT

7.1 Although the cab of the machine will protect you from most problems it is sensible to wear Steel Toe-capped boots as you will have to get down from the cab and work on site at some time. For this reason you should have your hard hat and gloves with you as well. Depending on the nature of the work it may well be sensible to wear ear defenders and/or goggles (or at least have them available).

8. STARTING UP

8.1 When climbing in and out of the cab always use the steps and grab rails. Never jump down from the cab except in an emergency as you could injure yourself by jumping onto an obscured object such as a sharp reinforcing bar.

8.2 Always start on a fast idle using the cold start (preheat) if necessary and allow the engine to warm up. The warm-up time of the hydraulics (hydrostatic warm up) can take some time, especially in cold weather. The movements of the machine may be slow, sluggish and the rams may not extend to their maximum. Operating the controls working every ram slowly can reduce the warm-up time. This also helps you with familiarisation with the controls. It also checks if everything is working so you don't find a problem after 'hours' of tracking to the site. Find out just what the machine will do – three movements at once, two movements at once, can you track and operate the arm at the same time?

8.3 Check

- Warning indicators e.g. battery charge etc. should all be off
- Gauges read normal
- Check the operation of the controls as they may be "wired" differently from normal
- Adjust the seat for comfort
- Find the engine 'kill' switch and check that it works
- What controls the hydraulic isolation circuit actually isolates (depending on the machine the hydraulics are isolated by the red lever as you enter the cab or by lifting the left arm rest)

9. MANOEUVRING

9.1 Before moving off, check all around and move off slowly to the work site looking out for obstructions and height limitations.

9.2 If the machine is tracked then it should always be set up so that it goes forwards when the levers are pushed forward. This prevents "bunching" of the tracks, reducing wear and keeps the slack of the track on top. The bucket should be close in front of you. Track using your feet on the pedals as this keeps your hands free so you can raise or lower the bucket, the bucket should be kept just above the ground.

9.3 If the machine is tracking around site for any distance then the slew lock pin should be engaged, this stops the machine slewing under its own inertia. On larger machines this will be automatic but on smaller

machines it will be a manual pin probably located in the cab floor. When tracking on the highway this is mandatory.

9.4 To reduce strain on the tracks when turning keep both the tracks moving so the turn is gradual. On no account turn on the spot by pushing one track lever forwards and one back. Be aware of picking up mess, barbed wire, wire rope etc in the tracks. This can lead to a track coming off it's runners ("popping a track") once a track has been lost it can only be repaired where it stands – usually a very muddy job.

9.5 Keep personnel away from the swing area of the machine. If the machine is working close to a wall or other obstruction and it is closer to it than 600mm, the machine should be fenced off so that people can't walk in between and get crushed if the machine is slewed. The visibility when working is limited so before tracking back slew to improve your vision.

10. TRAVERSING INCLINES

10.1 Before traversing an incline, it may require grading so that it is not too steep and the top and bottom angles are not too sharp. Only go straight up and straight down an incline, with the track drive to the rear (normal tracking). Never try to cross an incline at an angle, as there is a greater risk of toppling the machine.

10.2 When going uphill track with the arm in front of you. Extend it and the bucket to their maximum, keeping it low down as this puts a lot of weight up hill and acts as a counterbalance to prevent the front of the tracks from lifting. If extra counterweight is required fill the bucket. In slippery conditions such as wet clay or with a rubber tracked machine it is also possible to dig the bucket in at the top of the bank and pull yourself up at the same time as you are tracking.

10.3 Going downhill, again, keep the arm in front of you but keep it tucked in as close as possible so that it does not act as a counterbalance. Keep the bucket just above the ground so that if the machine does tip it will only go as far as the bucket.

10.4 Great care must be taken when tracking small sized excavators up and down pavement kerbs for tipping and toppling reasons.

11. WORKING

11.1 The working position should be on stable, level ground (if it is not level then make it level). This is the only way to dig a trench with vertical sides and a flat bottom and makes grading easier. The machine is most stable when working directly over the tracks i.e. the arm is parallel to the tracks. This is not always possible to do especially when dredging along a canal. Additional attention must be given when working at right angles to avoid toppling of the machine:

- Avoid overfilling bucket
- Never slew with a full bucket at maximum reach. Bring the bucket in close first
- Always slew slowly

11.2 Excavators are very stable machines but are capable of digging under themselves. Most accidents occur due to undercutting and the ground collapsing from beneath them. Therefore always check the working face regularly, as it may not be as stable as you think it is!

11.3 Always work within eyesight of someone else. The comfort and security of a large excavator cab can seem impregnable but every year accidents such as roll overs, collapses and drownings occur where the machine operator was injured and help was unavailable.

JCB JS240/260

Bucket reaches full load as the stick reaches vertical, avoiding undercutting

12. BEST DISTANCE FROM THE EDGE

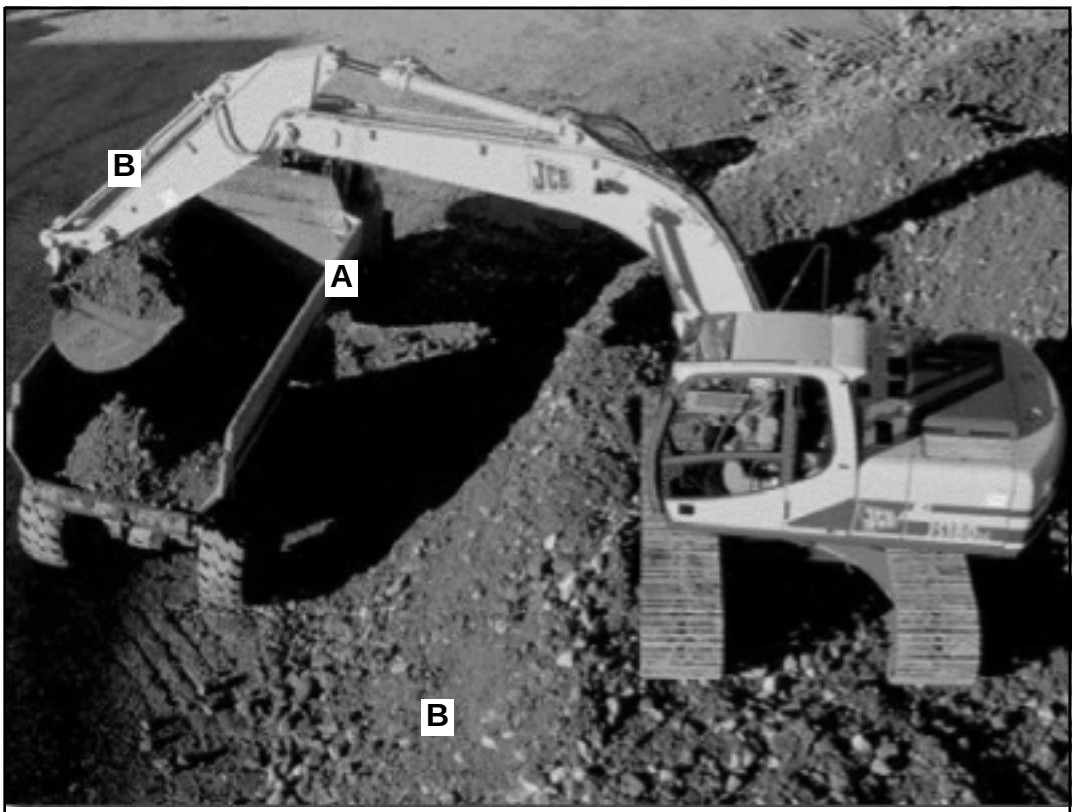
12.1 The machine should be positioned so that the stick is vertical when the bucket reaches full load. This gives maximum breakout forces. If the machine is too close to the edge then undercutting will occur and also time is wasted bringing the stick back out. If the machine is too far from the edge the breakout force is reduced.

13. USE OF A BANKSMAN

13.1 A banksman should be used at times when a wall obscures your vision, or when digging a deep excavation. They can give direction signals, watch for undercutting and look for services, pipes or cables if they are expected to be present. Make sure that all hand signals are agreed – see HSE guidance, "Know your Crane Signals". To avoid confusion only take signals from one person.

14. IDEAL BENCH HEIGHT, TRUCK DISTANCE AND LOADING TRUCKS

14.1 When loading a dumper never load "over" the seat or cab. Always ensure the operator has got off the dumper and turned it off before you start to load. The one exception to this is if it is fitted with a rock cab.



JCB JS180

A. The boom stick hinge pin is over the truck body
B. The bench height is = stick length

14.2 Indicate to the driver of the dumper where you want it to be placed by holding a filled bucket at the required position.

14.3 Excavators work best with the dumper at a lower level than they are. Ideally the truck body should be below the boomstick hinge pin. If the work is being carried out on stable ground the bench height should be equal to the stick length, the bench height should be reduced for unstable materials.

JCB JS130

Truck positioned as close to machine centre line, with work angle kept as small as possible

15. OPTIMUM WORK ZONE AND SWING ANGLE

15.1 For maximum productivity the work angle should

be kept to 15^{o} either side of the centre of the machine or about equal to under carriage width. Trucks should be positioned as close as possible to the machine centre line. This avoids excessive time slewing to load behind you.

16. SPOIL DISCHARGE TO GROUND

16.1 Spoil should be discharged well clear of the excavation to avoid its weight causing the side of the excavation to collapse. If the excavation is 1m deep or less the spoil should be deposited at least 1m away from the edge, 2m deep 2m away and so on. It should be deposited tidily along the line of the trench to make it easier to fill, not in one great big heap.

JCB JS200/220

A. Depositing excavated material

17. ANGLE OF RESPONSE

17.1 All soil types have different abilities to remain stable. They will assume a natural angle of response. This means that when you deposit soil on the ground the pile forms its own angle depending on the material. Excavations cut to this angle are called battered. The table below shows the angles of response for different materials and the effects of water content.

MATERIAL	DEGREES
Drained Clay	45
Wet Clay	16
Gravel and Sand	40
Wet Sand	22

Angle of Response

17.2 There is quite a difference between dry and wet materials and their angle of response. It is important to remove the water from excavations to avoid collapsing.

18. TRENCH EXCAVATIONS

18.1 Narrow trenches are dug to take foundations, for buried services and the most common waterway restoration job – bywash pipes.

18.2 Vertical or straight-faced trenches may require additional temporary support but have the advantage that the minimum amount of soil is removed and therefore requires less work in the excavation and back filling.

18.3 Conversely battered trenches do not require any additional temporary support but take extra time to dig and backfill.

19. TRENCH SUPPORT

19.1 No personnel should enter a vertical faced trench excavation if the sides are unsupported.

19.2 A dragbox is used in stable ground. This consists of two metal plates, 3m long by 2m high, which are braced apart. The excavator lifts this into the trench allowing personnel to work below ground without risk of the excavation collapsing in on them. It is very convenient for laying pipework as, when the pipe is laid, it can be pulled along the trench to the next position.

19.3 Other types of support are timber planks with bracing and sheet metal piles with waling, but these tend to be costly and time consuming to install.

20. WORKING *NEAR* OVERHEAD CABLES

20.1 Always assume that overhead cables are live. You do not have to make contact with them to get electrocuted. Electric arcs can jump considerable distances if the right conditions are present e.g. very dry air. The Electrical (Overhead Lines) Regulations 1970 give minimum distances of conductors from the ground. Often the voltage is marked on the pylon.

400KV	7.3m
275KV	7.0m
132KV	6.7m
33-66KV	6.0m
11-33KV	5.2m

Minimum height of overhead cables

20.2 Do not compromise these distances by tipping, landscaping or storing equipment beneath them.

20.3 The local area Electricity Company should be consulted in advance of work commencing to allow them to advise on heights, safe distances and to establish whether the work requires the line to be made dead or what suitable precautions need to be taken to avoid an accident. These precautions are outlined below.

20.4 If the line can only be accessed from one side then a barrier need only be erected on this side. A barrier is required on both sides when access can be gained from both sides. The barrier can take the form of:

- A post and rail fence
- A tension wired fence (earthed at both ends)
- Large steel drums filled with rubble and placed at intervals
- An earth bank not less than 1m high marked with posts to stop vehicles
- 12x12 timber (old balance beams)

20.5 Barriers should be as distinctive as possible, painted in red and white stripes, or red and white hazard tape or bunting can be used on wire fencing. The barrier should be placed a minimum of 6m, plus the maximum reach of the largest machine away, from the line. The Electricity Company may specify a greater distance than this.

21. WORKING *UNDER* OVERHEAD CABLES

21.1 Where it is necessary to work inside the safety zone outlined above then additional precautions are required:

- Specific advice should again be sought from the Electricity Company
- Use a smaller machine whose maximum reach won't go above the safety zone around the cables
- If a larger machine is to be used then welding chains on the boom and stick should mechanically limit it so that it can't reach into the unsafe zone around the cables

21.2 If an accident occurs with an electric cable then don't climb down from the machine but jump as far away from the machine and conductor as you can and roll away. Never assume that the electric conductor is now dead as it may be automatically re-energised at the sub station several times, depending on its importance. Call the Electricity Company for assistance.

22. DEALING WITH UNDERGROUND SERVICES

22.1 The utility companies should be consulted as to the location of their services on site. They will often provide a map of their position; also look out for marker posts that indicate a service is below, what it is and how deep it is. Never rely on the plan being 100% correct.

22.2 Before starting work look for manholes or service ducts and then use a cable finder to mark out the locations. When digging in this area run the teeth through the ground taking away a small amount of material at a time. Most pipe work is laid on gravel or sand to help level it. It is then covered with the bedding material before it is back-filled and compacted. Electric and gas pipes also have a yellow plastic tape laid into the trench above the cable before they are back-filled, to warn you of what's below so you and your banksman should be looking for these as an indicator that you are getting close. Always dig the last bit by hand until you are sure of the depth of the utility.

23. USE AS A CRANE

23.1 An excavator can only be used as a crane if it is equipped to do so. Check that the load does not exceed the object handling capacity of the machine. An excavator lifting capacity depends on its weight, centre of gravity, its hydraulic capacity and the lift point position (lift to the front or side and at what reach). The lifting capacity also varies with the load position i.e. below ground and above ground. The lifting chains should be shackled to the lifting eye at the bottom of the stick, not wrapped around the bucket.

23.2 If a suspended load of over 1000Kg is to be lifted then Hose Burst Check valves must be fitted to the boom rams and an Overload Warning Device fitted. A suspended load of under 1000Kg only needs a notification prominently displayed i.e. SWL (safe working load) 1000Kg.

24. TYPES OF BUCKETS AND DIFFERENT TYPES OF TEETH

24.1 A machine is provided with a set of buckets that are suitable for it. As a general rule, wide buckets are used in easily dug soils and narrow buckets for harder, more compact materials. On harder materials the teeth play an important part too. There are many types of teeth, with different profiles and lengths all for different materials.

24.2 For digging into a hard material use a narrow bucket fitted with short teeth.

24.3 It is possible to catch the teeth of the bucket on the track and dozer blade so care should be taken to avoid this.

24.4 In dredging and profiling, a ditching bucket is used. These have no teeth and holes in it to allow water to drain out. Because the material being moved is soft the buckets can be quite wide.

24.5 Some machines are fitted with a quick coupler attachment where buckets can be interchanged without leaving the cab. These attachments can add extra length onto the stick so care must be taken with these and with large buckets not to drive them into the cab.

24.6 A clamshell bucket can also be fitted to an excavator. Here the bucket ram is disconnected and the clamshell is hung by a universal coupling from the end of the stick. It is connected to the auxiliary lines and is opened and closed by the auxiliary pedal in the cab. It is particularly useful for emptying dredgings from mud barges. The rules for working at right angles to the tracks should be observed here, as the bucket is free to swing and at full reach it could swing out and topple the machine.

24.7 Most machines can also take a breaker attachment, which is also controlled by the auxiliary pedal in the cab.

24.8 When digging foundations, choosing a bucket with the same width as the required foundation can save a lot of time. There is no need to install any shuttering, since the foundation is dug to the required depth and the concrete can be poured straight in.

25. SHUT DOWN PROCEDURE

25.1 When operations are finished, park the machine on firm level ground away from any excavations and:

- Lower the arm so the bucket is on the ground with the teeth or blade of the bucket flat to the ground (this avoids injury to passers-by). The stick should be vertical (to save space) unless the machine is to be parked for a long time in which case retract all rams as much as possible to avoid rusting.
- Lower dozer blade to ground (if fitted)
- Shut down engine after having slowly reduced the engine rpm
- Waggle all control levers to release pressure
- Clean out the cab
- Climb down from the cab using steps and handrails
- Remove key and lock windows and cab
- Refuel the machine at the end of the working day to prevent air spaces in the tank and therefore avoid condensation building up in the tank overnight
- Fit security shields
- Remove accumulations of soil, paying particular attention to track assemblies

25.2 In severe weather conditions it will be advisable to park the machine on timber to prevent the tracks freezing to the ground.

26. TRANSPORTATION OF EXCAVATORS

26.1 Excavators are relatively slow moving machines, and because of this they tend to be moved from job to job by a road vehicle, either a transporter or a van and trailer. This saves a lot of time and also saves wear on the machine.

26.2 Check on police authority notification (usually via your haulage contractor) when planning transportation.

26.3 Before loading or unloading an excavator from its road transport, check that:

- The transporter is capable of taking the weight of the machine and all its attachments
- Ground surface at the load/off-load point is stable and capable of taking the weight of the combined load of the transporter and excavator and that the wheels of the transporter will not sink in to the ground causing instability
- There are no overhead obstructions
- All of the transporters components are parked in a straight line and the park brake is applied
- When the excavator positioned on the transporter the slew lock pin should be fitted, all attachments lowered and the machine secured

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Practical Restoration Handbook

Demolition and Scaffolding

by

Mick Beattie

CONTENTS

1. INTRODUCTION

1.1 This chapter of the Practical Restoration Handbook deals with two subjects often associated together – demolition (especially using powered breakers) and scaffolding.

1.2 Health and Safety matters directly appropriate to the subject are dealt with here but the overall subject of Health and Safety is considered in depth in the PRH Chapter "Health and Safety (Sections 1–4)". It is strongly recommended that this is read before any demolition or scaffolding is undertaken.

1.3 A comprehensive text on demolition and scaffolding would be very large indeed. Demolition techniques and skills take many years to learn. In addition the wide range of jobs and conditions that are encountered on restoration sites across the country mean that the planning and carrying out of demolition is very specific. For this reason only golden rules and generalisations are given here, together with tips that have been found applicable on many sites.

1.4 Please note that throughout this chapter the term **breaker** is used, although it is accepted that there are many variations (Kango, Pacebreaker, jack hammer, etc.) from site to site.

1.5 Similarly scaffolding is not only site specific but has considerable legislation and rules associated with it. The design of complex scaffolding is best left to appropriately trained individuals and so this chapter again seeks to give only the rules for regular scaffolding. It is hoped that this will enable the reader to:

- design and erect simple scaffolding,
- erect more complex scaffolding to an already prepared design and,
- identify defects within scaffolds even if professionally erected.

1.6 It should also give the visiting volunteer an ability to assess existing scaffolding he encounters and ensure he does not overload it's capacity. Note that only "access" scaffolding is discussed here, the subject of "support" scaffolding is not included as this is a separate subject best left to the design engineers. Similarly only conventional "tube and clamp" scaffolding is discussed, where "quick fit" towers are used then the reader is strongly advised to take the time to read the manufacturers "recommendations for use" and adhere to them. The supplier has a "duty of care" to provide these recommendations. (HSE guidance is available on Tower Scaffolds, see Section 4 Recommended reading).

2. DEMOLITION

2.1 Health & Safety

2.1.1 There are Health and Safety considerations that must be in place before and whilst the work is being carried out, be it demolition by hand or breaker. These should be an integral part of the planning process not just standard clauses tacked on the end. Two elements should be considered: firstly the job itself should be designed to minimise the risks to the breaker operator and also to everyone else on the site, secondly the operator should be given adequate protection to ensure he can carry out the job safely.

2.1.2 Demolition should be a controlled process. This means generating the rubble at a speed that it can be dealt with.

2.1.3 The rules covering eye protection are quite simple – if an eye injury can occur then adequate eye protection must be worn.

2.1.4 Gloves should be worn on any demolition site, as protection against grazes and dirt and to ease fatigue.

2.1.5 Where the job may be expected to generate significant levels of dust then respiratory protection must be provided. Normally this just takes the form of dust masks, however, in extreme situations breathing apparatus may be necessary. When providing dust masks check that it is adequate for the dust you expect – there are many different grades for different types and sizes of particulates. Wetting the material down may help keep dust under control but ensure that it does not make the site slippery or pose a risk with any electricity.

2.1.6 Other items of Personal Protective Equipment (PPE) would include safety boots and a hard hat (both essential on any demolition job).

2.1.7 As a breaker cuts into a hard material, such as concrete, bits of the material can be thrown up over quite a wide area – you may therefore need to consider PPE for those working nearby to the job, and possibly take steps to protect the public as well.

2.1.8 One point that must be clearly stressed to all about to partake demolition on waterway sites – generally there are only two types of demolition that are undertaken: demolishing very old brickwork from a time when quality control was unheard of and demolishing concrete blocks etc. that were put in a few decades ago where a cheap fix was required. This means that the waterway structures are very variable to say the least. Sections of wall that look very solid may well not be tied in the overall structure and collapse with a single blow. Retaining walls may well have only been supported by the water in the channel and so when you de-water to re-patch the wall. . .

2.1.9 The message therefore is that it is essential to have someone competent to inspect the job before demolition starts and to instruct all those involved in the demolition on what to look out for. Cracks, etc. should be marked with chalk, or spray paint where chalk will wash off, and inspected regularly.

2.1.10 A further complication is that often it is only the area around the waterline that has deteriorated and so partial demolition will be required. An example of this is a lock chamber wall that requires demolition of the section around the low-level waterline. It is obviously dangerous to demolish a section of wall with the rest of the wall still on top of it. Where there is any risk of collapse the job should be assessed by a competent person and advice on propping and supporting the structure given.

2.2 Planning a Demolition Project

2.2.1 Firstly the question needs to be asked – "Does it need to come down?" Can the work be achieved by underpinning, anchoring, etc? This is probably the realm of qualified Engineers, however, some

guidance is given in PRH "Bricklaying". Once it has been established that demolition is necessary then it is important to think the whole job through. Consideration needs to be given to:

- Timing to minimise interference from other jobs on site and the public
- Technique to be used
- Equipment to be used
- Any special training required
- PPE
- Additional props or support during the demolition
- Safety fencing
- Is the structure reinforced in any way? (If steel reinforced then boltcroppers or a cutting saw will be required)
- Access
- Pollution (especially noise and dust)
- Fuel for equipment
- Recruiting extra volunteers (such as visiting groups) to reduce project duration
- Time of year
- Removal of rubble from the immediate area during demolition
- Storage of rubble
- Removal of rubble off site (possible reuse of rubble for building up towpaths, etc.)

2.2.2 Any boundaries or limits to the demolition should be clearly marked.

2.3 Demolition by Hand

2.3.1 This doesn't actually mean "by hand" but refers to demolition using hand tools.

2.3.2 Demolition using hand tools can be very efficient as it requires far less set-up time and so for small "easy" sections, or sections where the utmost care must be taken (e.g. if it is hoped to reclaim the bricks) it may well be the sensible option.

2.3.3 Always use chisels with hand guards and ensure that any mushroomed heads are ground down. The use of hammers and wrecking bars is also discussed in PRH "Hand Tools". Don't extend wrecking bars by sliding scaffold tubes over them. Pick the hammer you feel comfortable with, they come in lots of sizes; you may well be more effective with a 7lb sledgehammer than a 14lb one or a 2lb club hammer rather than a 4lb one.

2.3.4 The usual technique is the same as with a powered breaker – work along the weaknesses of the section to be demolished. This usually means for brickwork that it is best to cut along the mortar joints rather than attempt to cut through the brick itself. Always cut away easily handleable sections – while it may look impressive to lever a half tonne lump of masonry out of a wall what are you going to do with it then?

2.3.5 Even the most skilled demolition using breakers will require some element of cleaning up using hand tools before construction can begin.

2.4 Why Use Breakers?

2.4.1 Breakers cost money, they require maintenance and training, they are easy to break (especially if misused) and are often easy targets for thieves. Given this it seems easiest to stick to hand-tools. Demolition, for example, can be done quite successfully with the use of hammers and chisels. Brickwork can be cut out and foundations excavated through hard clay all with the use of hand tools. However, the time spent by your volunteers should be used to the best advantage and it is often the case that powered tools speed up the job.

2.4.2 There are also Health and Safety considerations; the use of a sledge hammer and wrecking bar may lead to a less controlled demolition and a tired, less careful navvy (outbreaks of excessively dangerous testosterone may also result). To complete the demolition in one day means that you don't have to spend the weekends erecting safety fences and spend the midweek worrying about whether these precautions have been breached.

2.4.3 Finally there is nothing quite so demoralising for volunteers as a long tedious demolition that runs on for seemingly endless weekends.

2.4.4 Given this it can be seen that it may well make sense to use breakers. Before we can continue with a discussion on types of breakers and techniques it is necessary to consider additional Health and Safety points.

2.4.5 One mistake often made is to say that these considerations only really apply to people using breakers day after day. Whilst "duration of exposure" is a valid consideration it does not mean that because you are an office worker who only uses the breaker for a Saturday morning you do not need to consider all aspects of safe use. It should be noted that there is a risk and it is everyone's responsibility to reduce the risk.

2.4.6 Certainly on longer projects (such as a week long Canal Camp) a careful check should be kept on the individuals hours of use. It may be necessary to limit the time people actually use breakers.

2.4.7 The most obvious risk is that of excessive noise levels, from the breaker, the power source and the job itself. When a breaker is being operated then noise levels will almost certainly rise above the level that can cause damage to hearing. This is discussed in PRH "Health and Safety – Section 1", however, as a rule of thumb, if a person needs to raise their voice above a normal talking level to make himself heard then the background noise level is too high and hearing protection should be worn. The person using the breaker is most at risk, but also at risk are those people on the site within the area. It is a good idea to have ear defenders available for those carrying out the work and ear plugs for those on nearby parts of the site as these are more comfortable and less restricting than ear defenders.

2.4.8 Additionally you also need to consider your neighbours – will they appreciate being woken up at 9am on a Sunday morning by the sound of a demolition gang?

2.4.9 With breakers there is an additional risk as prolonged use of breakers can cause white finger syndrome. Gloves have been specifically designed to help reduce the risk of white finger and these are heavily padded in the palm and across the base of the fingers. It is unlikely that a volunteer will develop the syndrome as it is most commonly associated with miners and people involved with the use of breakers on a daily basis over a period of time. However, the risk of sprains and aches must be emphasised to anyone using breakers and if aches occur then a rest should be compulsory. This rest may well be of the order of days, indeed some people may find that they cannot operate breakers without problems developing and these people should obviously be given other jobs.

2.4.10 One less obvious risk to Health and Safety is the consideration of the actual weight of the breaker and the manual handling of the breaker. There is no point in using a high powered breaker if you do not have volunteers who can lift it or control it. A volunteer must be able to control the breaker. This leads to a consideration of which breaker to use.

2.5 Types of Breaker

2.5.1 Breakers have evolved over many years resulting in a vast selection of breakers, each designed for specific tasks. Power to the breaker needs to be the first consideration. Breakers can be electric (110 or 240 volts), hydraulic and pneumatic and specific site conditions and the task to be completed will determine the choice. Obviously, if possible, it makes sense to use whatever power source you use on the rest of the site but do not fall for the "well we already have a generator so we'll use an electric one" argument. If the job deserves a hydraulic breaker then you should hire one in. The relative merits of the various power sources are discussed in detail in PRH "Plant" but the main advantages and disadvantages are given here.

2.5.2 One point that must be made is that whatever the choice of power source everyone on site should be aware of the procedure to switch off (or make safe) the power source. It is too late to try and instruct them when a problem has occurred.

2.5.3 **Electric breakers** are available throughout the power range from small hand-held breakers often doubling up as hammer drills through medium breakers, e.g. a Kango 950, through to road breakers. These are the most common breaker used in canal restoration as the small and medium breakers are lightweight and easy to use particularly when cutting out using the tool horizontally. They are readily available to hire from small hire shops. Owing to the extreme conditions encountered on most restoration sites the author strongly recommends that 240v breakers are not used by volunteers on restoration sites.

2.5.4 The electric cable is much easier to handle than a heavy air or oil hose. One important point is to always ensure that the cable supplying the breaker is sufficient to cope. Too lightweight a cable will create a voltage drop which means the breaker will be running on lower volts than it is meant to. This actually causes the breaker to overrun and it will overheat. A 110 volt Kango running on 100 volts will burn out within an hour!

2.5.5 The most common accident does not actually involve the breaker but the electric cables. Don't let the cables dangle unsupported, always ensure any junction boxes are secured out of harms way and keep the connectors clean and dry. Don't let rubble build up on top of the cable. If you suspect a cable is damaged then switch off the power, swap it and mark it up as faulty.

2.5.6 **Hydraulic breakers** tend to be classed as heavy breakers. This particular class of breaker is often referred to as a "Pacebreaker" (named after the leading manufacturer) and consists of a small power pack, usually on wheels, with two hydraulic hoses given flow and return hydraulic oil to the breaker. Because it is relatively small and self-contained it can be used on remote parts of the site although it is at least a two-man job to manoeuvre it. The hoses are often only approx. 4m long and are usually connected by quick release fittings and it is important to keep these clean.

2.5.7 **Air breakers** are the most powerful of the hand held variety and are usually powered by a large trailer mounted compressor. These are heavy usually requiring a dumper to move it around a site. They also require considerable discipline in their operation to ensure that the quick release couplings (usually known as "claw" or "bayonet") are not uncoupled while there is residual pressure in the hoses. The air is at a very high pressure and can easily blow contaminants such as oil and water under the skin where there is a serious risk to health. Ensuring that there is agreed procedure to release pressure before moving the equipment or rearranging the hoses (and that everyone involved knows this procedure) is the key to safe operation of air breakers.

2.5.8 **Other Breakers**. All the breakers considered so far have been hand-held. Also available are breakers that fit to an excavator. Most commonly known as "peckers" these peckers are heavy duty and take away the strain of using the breaker. Powered by either the machines hydraulic system or by a remote source these breakers can become a viable proposition if heavy demolition work is to be undertaken. Fitting these breakers is generally specialist and obviously you need to be competent with the excavator as well as the breaker.

2.6 Types of Tool

2.6.1 The tool referred to is the working end of the breaker. Over the years many different configurations have been developed. Each of these is for specific jobs:

- Chisel – cutting out of brickwork
- Spike – cutting into and breaking up concrete
- Bolster – cutting up brickwork and dressing edges
- Tarmac cutter – cutting straight cuts into tarmac before excavating
- Clay spade – cutting of clay when hand digging

2.6.2 The tool should be sharp, a blunt chisel or spike will make the job harder. If you are hiring the breaker then always check the tools and ask for at least one sharp one before you leave the shop. When hiring a breaker for the weekend, where the shop will be closed, the author suggests three tools is the minimum required.

2.7 Working Methods and Tips

2.7.1 The first consideration when working with breakers has to be Health & Safety. From this will come the correct working method. The two most common mistakes with regard to demolition are volunteers interfering with the access arrangements (i.e. removing scaffolding braces to get at a section of wall) and failing to keep the demolition area clear and "losing" their power cables, hoses, etc under rubble. The most common accident when working with breakers particularly on

scaffolding is tripping on rubble. A stiff broom and a shovel should be considered essential equipment when using a breaker. It is important to keep both the work and the area clear.

2.7.2 You do not have to be a gorilla to be successful at demolition. Skill, intelligence and the right choice of equipment can mean that even the most lightweight of volunteers can make good progress.

2.7.3 It is usual to work from the top of a structure down. Everyone should be clearly briefed as to the technique and in addition told what to look out for such as shifts or cracks appearing etc.

2.7.4 Especially be aware about working in or near water. Dropping a breaker into water whether air or electrically powered is not good. If it is an electrical one then switch off the power source and return the breaker for repair.

2.7.5 The usual technique for demolishing brickwork is the same as for demolition by hand: work along the mortar joints easing the bricks apart cleanly. This will be easier going and may allow some bricks to be reused. For concrete it is best to create a weakness by cutting along a line to split the slab into small handleable sections, rather than just demolishing the block haphazardly. For concrete a spike will tend to slip off less than a chisel-ended tool would.

2.7.6 Breakers are designed to break up the material, but if used incorrectly they can drill holes in it. When cutting up a slab or similar care should be taken to ensure that the tool does not become embedded in. This can be achieved by allowing the tool to cut in a short way then lift it clear and start at another point adjacent.

2.7.7 Do not be afraid to put down the breaker and pick up a hammer and chisel if it is more appropriate.

2.7.8 Generally speaking for every person operating a breaker you will need someone operating a shovel to clear the rubble generated. It is best to schedule the "clearers" and the "demolishers" so they work in "antiphase" i.e. the demolishers work for 10 minutes and then the clearers shovel up for 10 mins. This gives everyone regular breaks and is especially important where the clearers are working below the demolishers (for example when a chamber wall is demolished from a scaffolding).

2.7.9 With breakers the golden rule is to let the breaker do the work. The breaker is designed to do the task with the minimum of effort on the part of the operator. It is good practice to hold the breaker firmly without exerting undue pressure on the tool. Leaning on the breaker does not improve the performance to any great extent and simply tires the user out more readily.

2.7.10 Never use the breaker as a lever, it will drastically increase the chance of the tool breaking (which usually results in the breaker landing on your foot).

2.7.11 The handles on a breaker are often adjustable, set them so they are comfortable and you can manoeuvre the breaker easily.

2.7.12 Keep the area clear!

2.7.13 If you get the tool stuck then switch off the power, disconnect the tool and fit another one so that you can dig out the stuck one. This is one reason for always hiring a breaker with at least two tools.

2.7.14 When using breakers the operator can become tired very quickly it is therefore very important that breaks from the work are frequent. During breaks the breaker should be stored temporarily in a safe position where it is unlikely to fall over or become excessively dirty. The break from the noise is just as important as any other break so turn the power source off during the break if possible.

2.7.15 When working with pneumatic breakers extra care should be taken as ice can build up on the air exhaust from the tool. This ice should be removed periodically as required. It is also important to ensure that air hoses do not run through or droop into water.

3. SCAFFOLDING

3.0.1 It takes years to learn the skill of scaffolding. This chapter should hopefully enable those reading to have a clearer view of what elements go to make up a scaffold that is safe to use.

3.0.2 All scaffolds and working platforms should be properly constructed to provide adequate working space.

3.0.3 No scaffold may be erected, modified or dismantled, except under the supervision of an experienced and competent person, and the competent person before use should inspect all materials. The recognised indication of training in a scaffolder is the scaffolders record card. This is a scheme run by the CITB where scaffolders are grouped into three categories – trainee, basic and advanced. Those who work on access scaffolding less than 5m high are at present exempt from the scheme.

3.0.4 Care should be taken when handling scaffolding. Boards and tubes can be heavy and awkward to carry. No volunteer should lift a weight that is beyond their capabilities or above 25Kg, whichever is the lower. Fittings and clips should be passed and never thrown. Volunteers should check there are no power cables close to where they intend to erect or handle scaffolding. Volunteers involved with the construction, alteration or dismantling of scaffolds should be made aware of the dangers involved with these activities.

3.1 Planning a Scaffolding Project

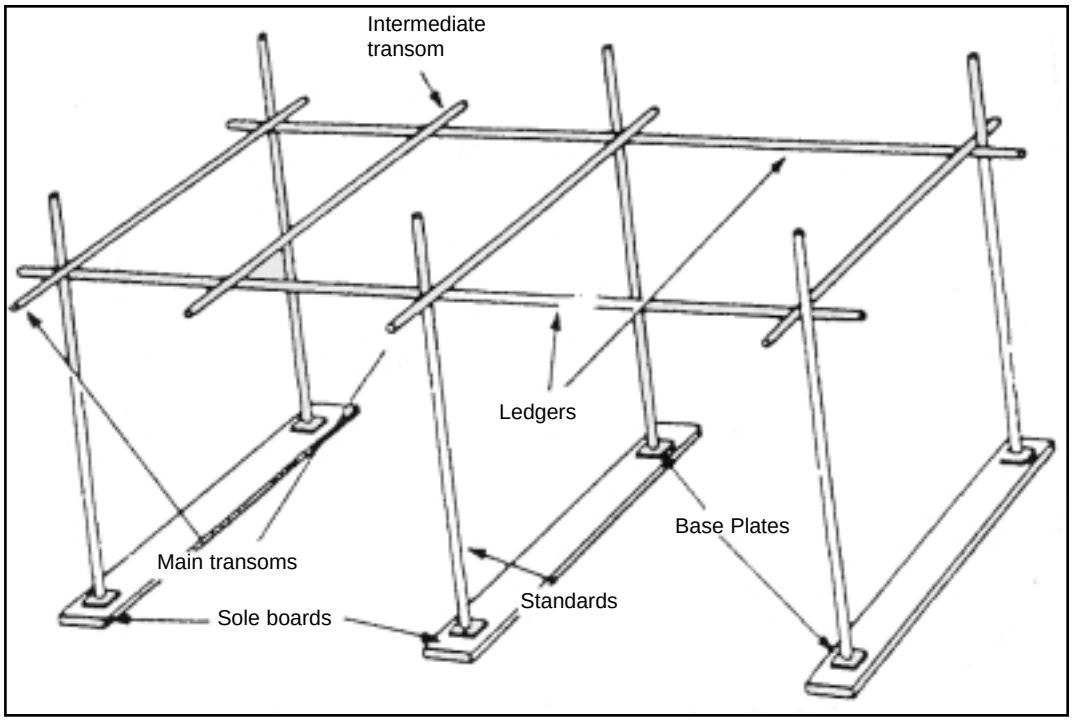
3.1.1 Before any scaffold can be built questions need to be asked.

- What is the scaffold for?
- What type of scaffolding is to be used?
- Where will the access to the scaffold be?
- What will the scaffold stand on?
- What materials, if any, are to be stored on the scaffold?
- How will the scaffold be secured in position?

3.1.2 Scaffolding should be properly planned to ensure that:

- It meets the working requirements and is designed to carry necessary loadings
- Sufficient materials are available
- It complies with the requirements of the Construction (Working Places) regulations 1996
- Members of the public are not put at risk

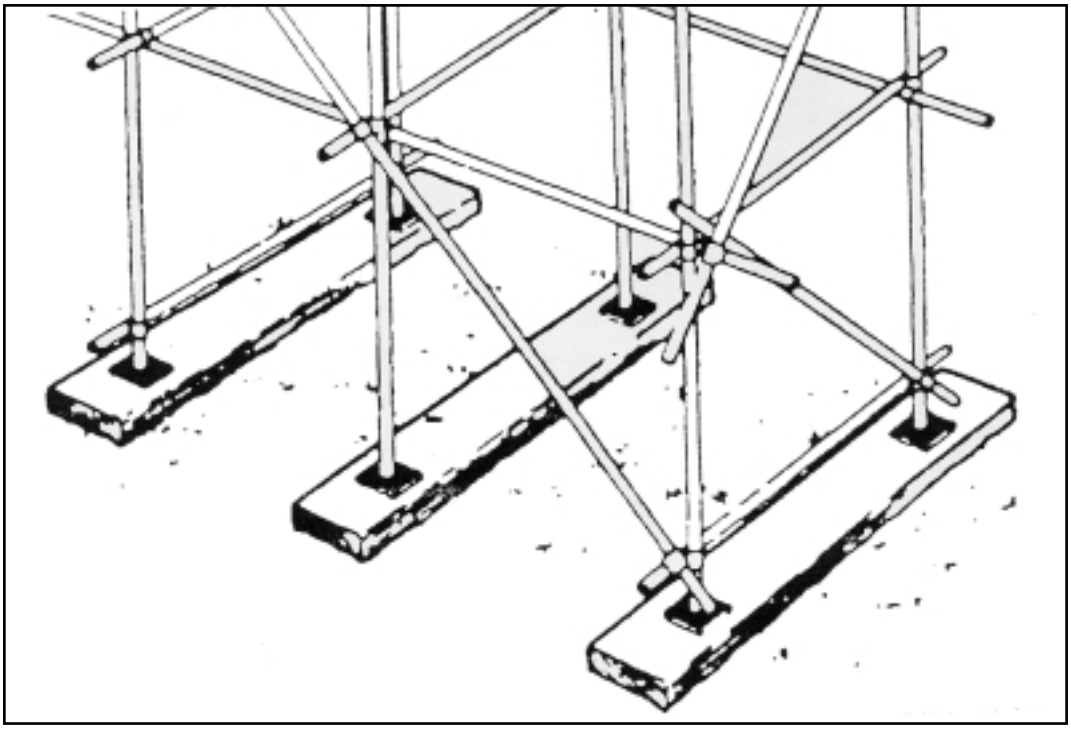
3.2 Basic Scaffolding Components



3.2.1 Tubes and fittings must comply with B.S.1139 part 1. The tube ends must be cut square. The tubes must be free from bends, corrosion, de-lamination or splits. The threads on fittings should not be worn. The bolt heads should not be damaged and fittings should be free from excessive oil or grease, which might reduce the friction grip.

3.2.2 Scaffold boards should comply to B.S.2482 and should not be split, warped, badly worn or treated in such a way as to conceal defects, i.e. by painting.

3.2.3 Scaffolding needs to be sited on a good foundation which will be strong enough to disperse the load of the scaffold as well as people working and any materials. Standards may be placed directly on a suitably strong foundation, however it is advisable to use 75mm x 75mm steel base plates (3' x 3'). On surfaces less suitable sole plates should be used. If the sole plate is made from timber it must not be less than 35mm thick (1.5'). The area of the sole plate under the standard is dependant on the ground. For hard ground the sole plate area should not be less than 1000cm^2 with a minimum dimension of 225mm.



3.3 Standards

Standards should be:

- Fitted vertically or inclined slightly towards the structure
- Spaced in such a way as to give adequate support
- Be on a base plate, or on a base plate and sole board, to prevent displacement
- Near to ledgers
- Fitted to have any joints staggered between bays

3.4 Ledgers

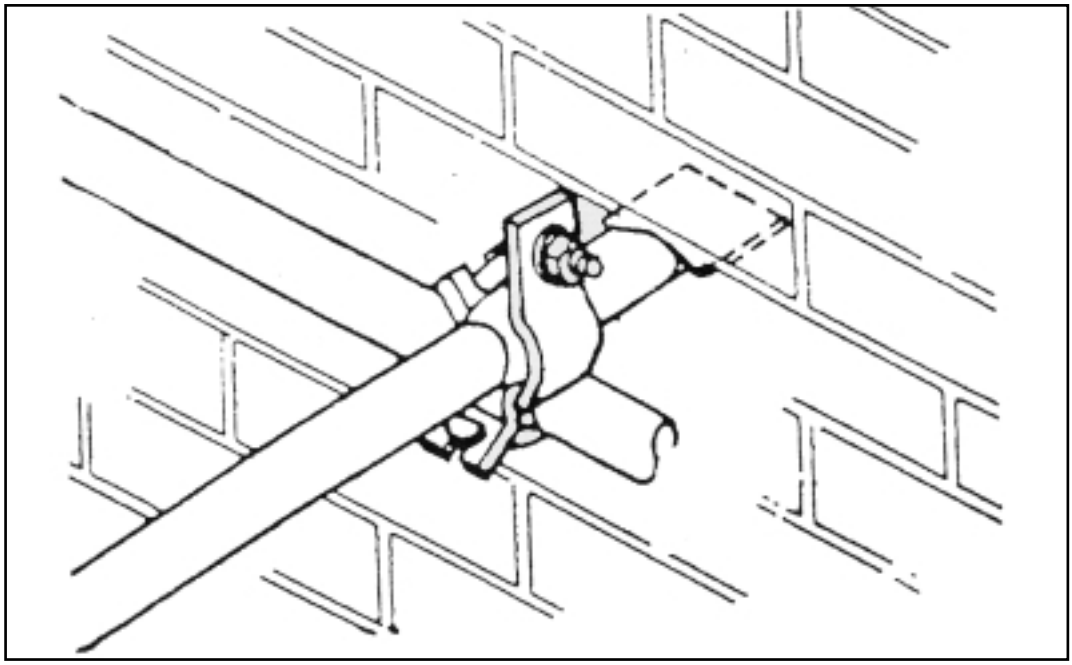
Ledgers should be

- Horizontal
- Securely fixed to inside of standards with right-angled load bearing couplers
- Fitted in such a way that joints are staggered between bays

3.5 Putlogs and Transoms

3.5.1 **Putlogs and Transoms should be**

- Horizontal
- Securely fixed to ledgers or standards with right-angled or putlog couplers
- Supported with flattened end placed right into the mortar bed joint of brickwork
- Putlogs should be approximately 75mm long.



3.5.2 The spacing for putlogs and transoms is determined by the thickness of the boards used. For boards 38mm thick the maximum spacing is 1.5m, for 50mm the spacing is 2.6m and for 63mm 3.5m is the maximum. Consideration must be given to the overall bay length. The maximum bay length is dependent on the width of the scaffold, this in turn is dependent on the type of use. B.S.5973 covers this in detail but basically:

Very light duty	2.7m Max
Light duty	2.4m Max
General purpose	2.1m Max
Heavy duty	2.0m Max
Special duty	1.8m Max

3.5.3 Putlogs and transoms used for non-boarded lifts should be fixed to either the standards with right-angled couplers or to the ledgers with putlog couplers and must be within 300mm of the ledger and standard connection.

3.5.4 The length of the putlog or transom will depend upon the scaffold use. In any eventuality the ends of the putlogs or transoms should not project an unnecessary distance outwards. The width of a scaffold deck is often referred to by the number of boards. For example:

For access and gangway runs	2 boards
Working platforms for men without materials or for passage of materials	3 boards
For men and materials	4 boards
For carrying trestles or other similar higher platforms	5 boards
Scaffolds wider than 5 boards should be specially designed	

3.6 Ledger Bracing

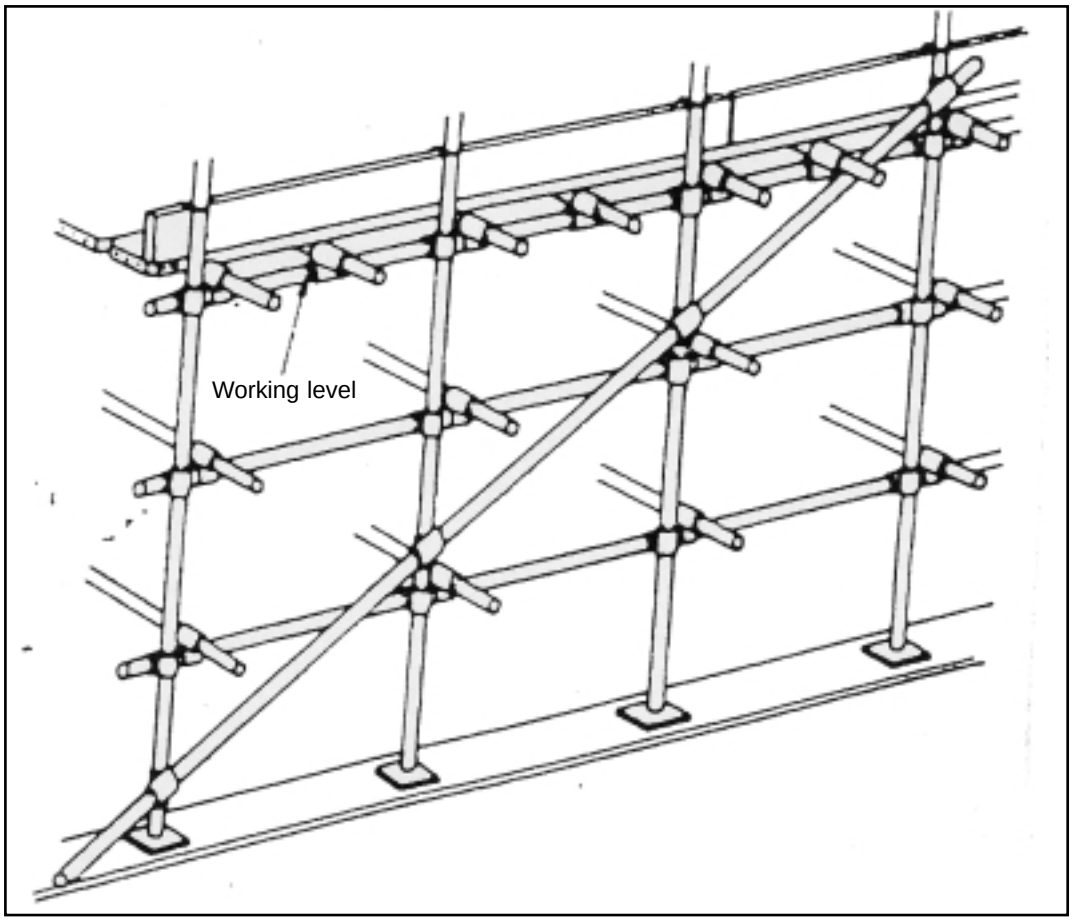
3.6.1 **Ledger bracing** should be fitted on alternative pairs of standards except where the width of the bays are 1.5m or less in which case they should be fitted on every third pair.

3.6.2 Ledger bracing should be fitted:

- To ledgers or standards using load bearing fittings
- To the full height of the scaffold
- To start at the base level

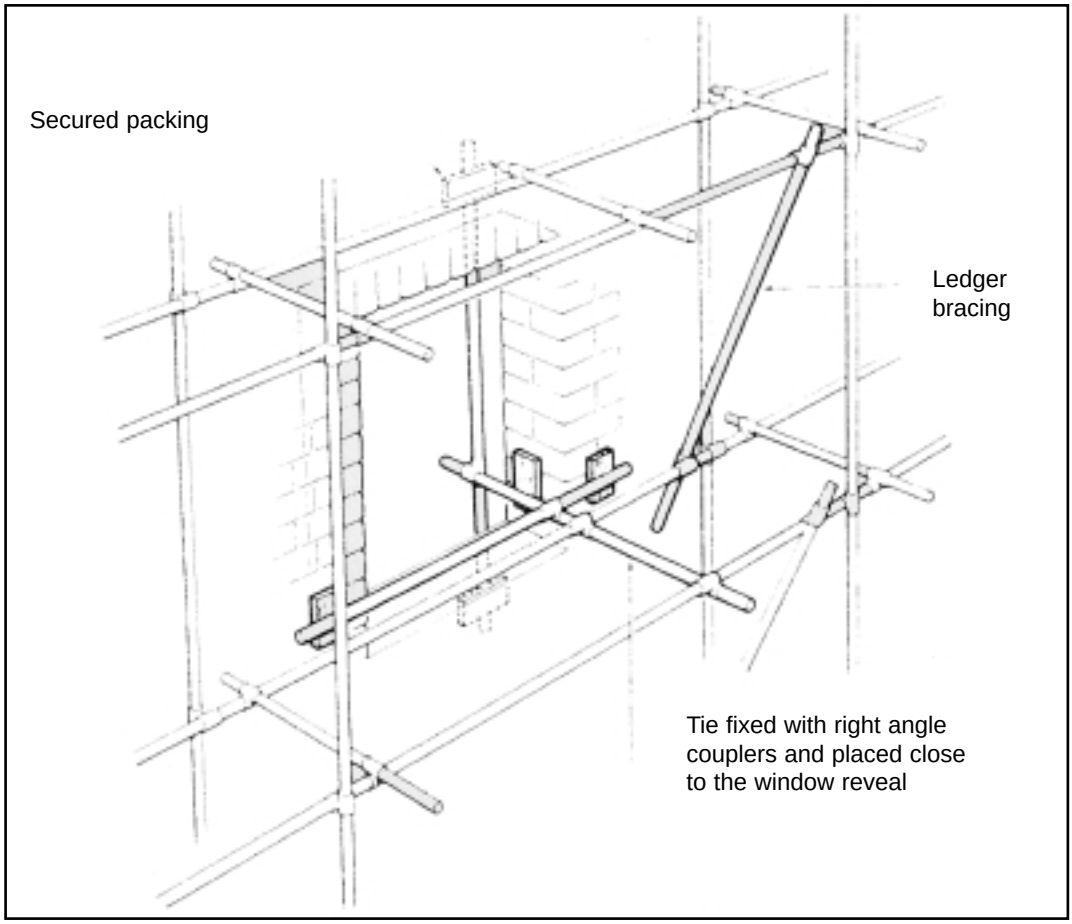
3.7 Longitudinal or Facade Bracing

Longitudinal or Facade Bracing should be fitted to all scaffolds that do not get the longitudinal stability by other means. The bracing must be connected to every lift of extended transoms with right-angled couplers or to every standard with swivel couplers. All joints should be made with sleeve couplers.



3.8 Ties

Ties link the scaffold to the structure and help resist inward and outward movement as well as going some way in giving additional longitudinal stability. Below are some examples of scaffold ties.



3.9 Scaffold Boards

3.9.1 The minimum any scaffold board may overhang a putlog or transom is 50mm. The maximum overhang is dependent upon the thickness of the board. This is outlined as follows:

Board thickness	Span between transoms	Max overhang
38mm	1.5m	150mm
50mm	2.6m	200mm
63mm	3.25m	250mm

3.9.2 Scaffold boards should:

- Be free from splits, shakes, excess knots, paint or concrete
- Be 225mm wide and not less than 220mm wide
- Not be treated in a way that would conceal defects
- Be banded or nail plated at ends
- Be supported by putlogs or transoms at the appropriate spacings
- Overhang at least 50mm but not more than four times the thickness of the board unless secured from tipping
- Be guarded against the wind causing the boards to lift

3.10 Decking

All decking or working platforms should be closely boarded to the full width where there is a danger of persons falling more than 2m or more. Where boards overlap each other bevelled pieces should be fitted to prevent tripped hazards. The decking should be of adequate width for the work to be carried out on it.

3.11 Guardrails

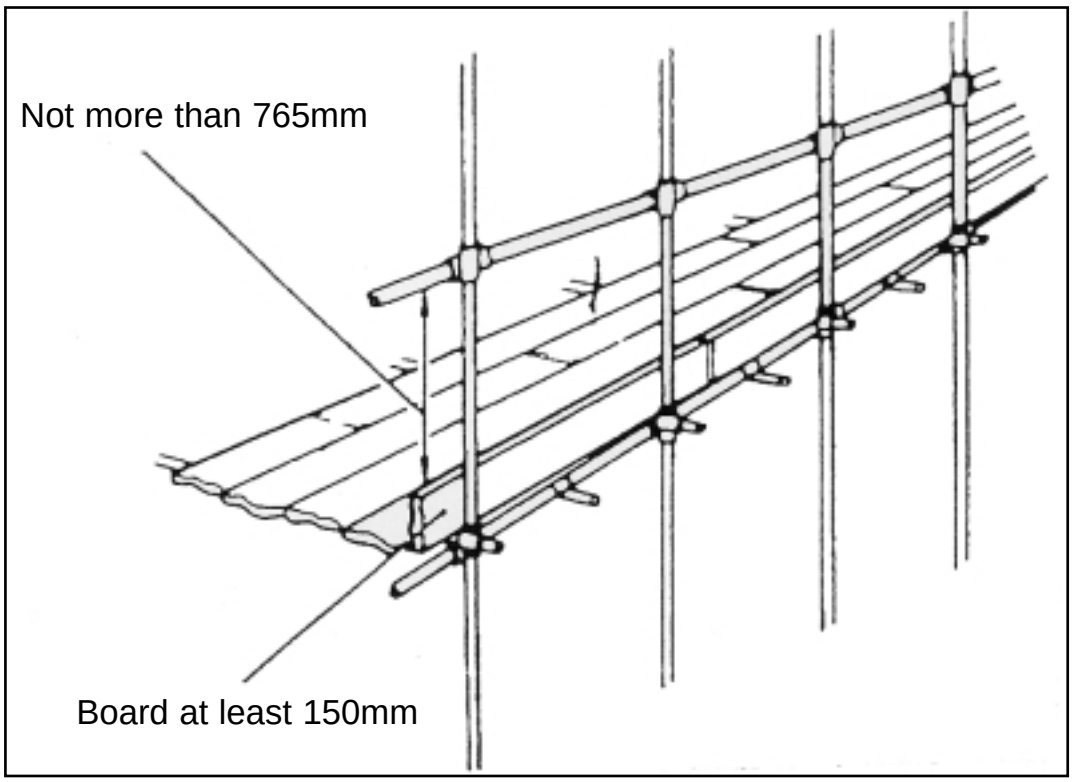
Guardrails must be provided:

- Where persons are liable to fall 2m or more
- At a level between 910mm but not more than 1150mm above the working platform
- If the guardrail is above 915mm, with a second guardrail or higher toeboard, so the gap between the guardrail and toeboard does not exceed 765mm
- Fixed inside the standards
- If the guardrail is removed for access of materials, it must be replaced as soon as practicable

3.12 Toeboards

Toeboards must be provided:

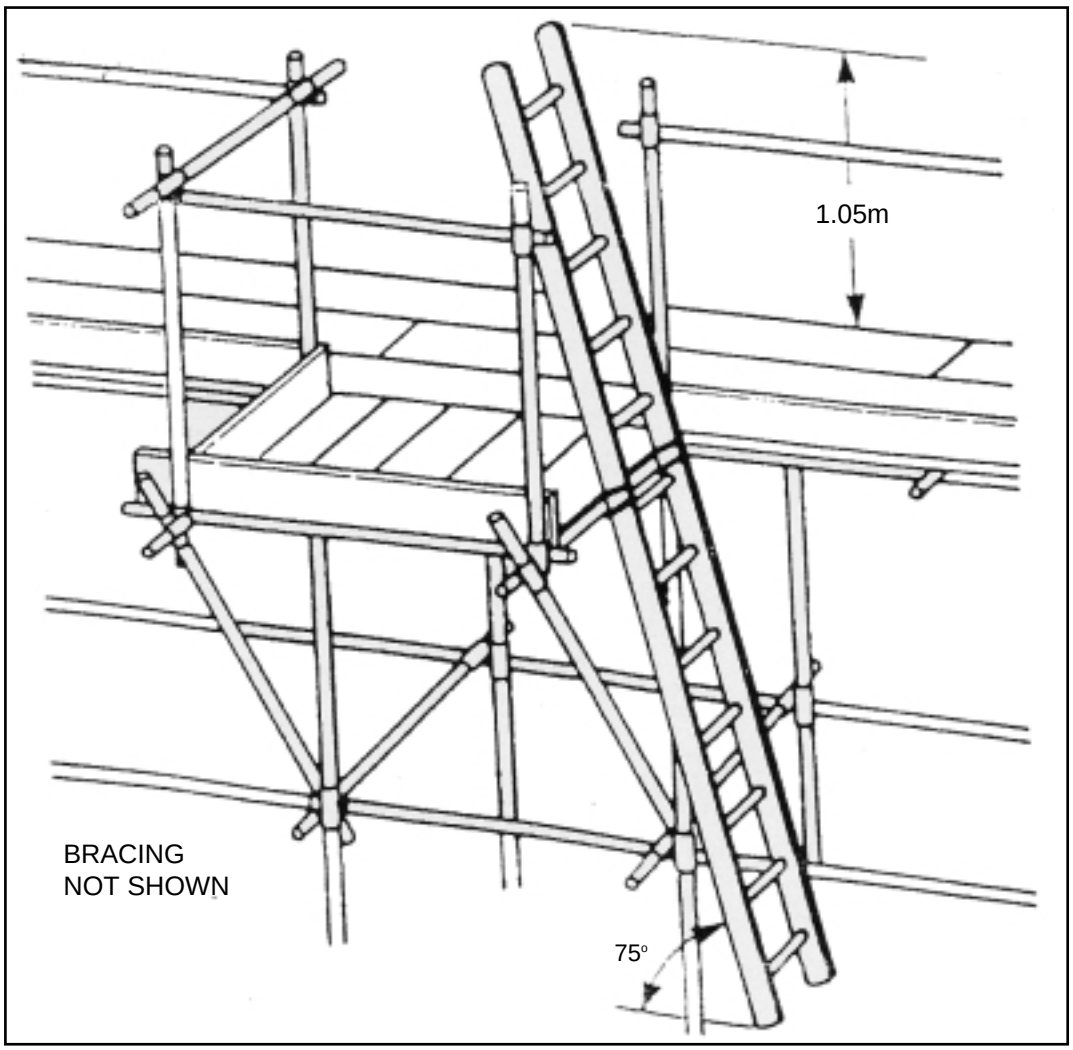
- To accompany guardrails
- At least 150mm high above the platform
- Fixed inside the standards, preferably with the use of proper clips



3.13 Ladder Access

Ladders used to the workplace should be:

- Not defective
- Not painted
- Placed on a firm footing
- So positioned as to give an adequate footing on each rung
- Be at approximately 750 (1 horizontal to 4 vertical)
- Extended 1.05m or 5 rungs above the working platform
- So that the vertical height does not exceed 9m
- Access holes for ladders must be no wider than 500mm and as small as practicable in other directions. Further guidance on access ladders is given in HSE Sheet SS2 (rev).



3.14 General Provisions

- Scaffolds must not be overloaded
- Beware the effects of wind on any sheeting you have on the scaffolding

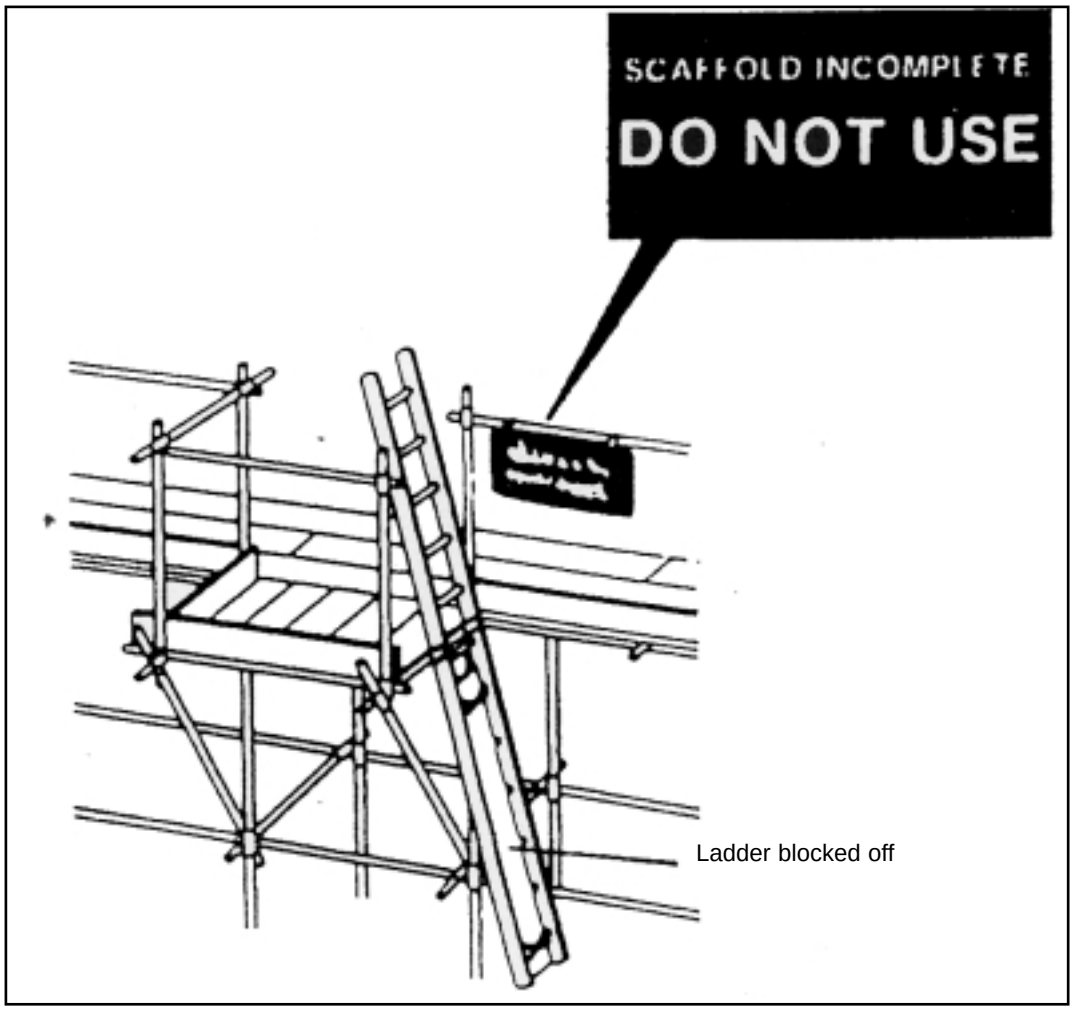
• Materials should not be stored on scaffolds unless they are intended to be used in a reasonable time

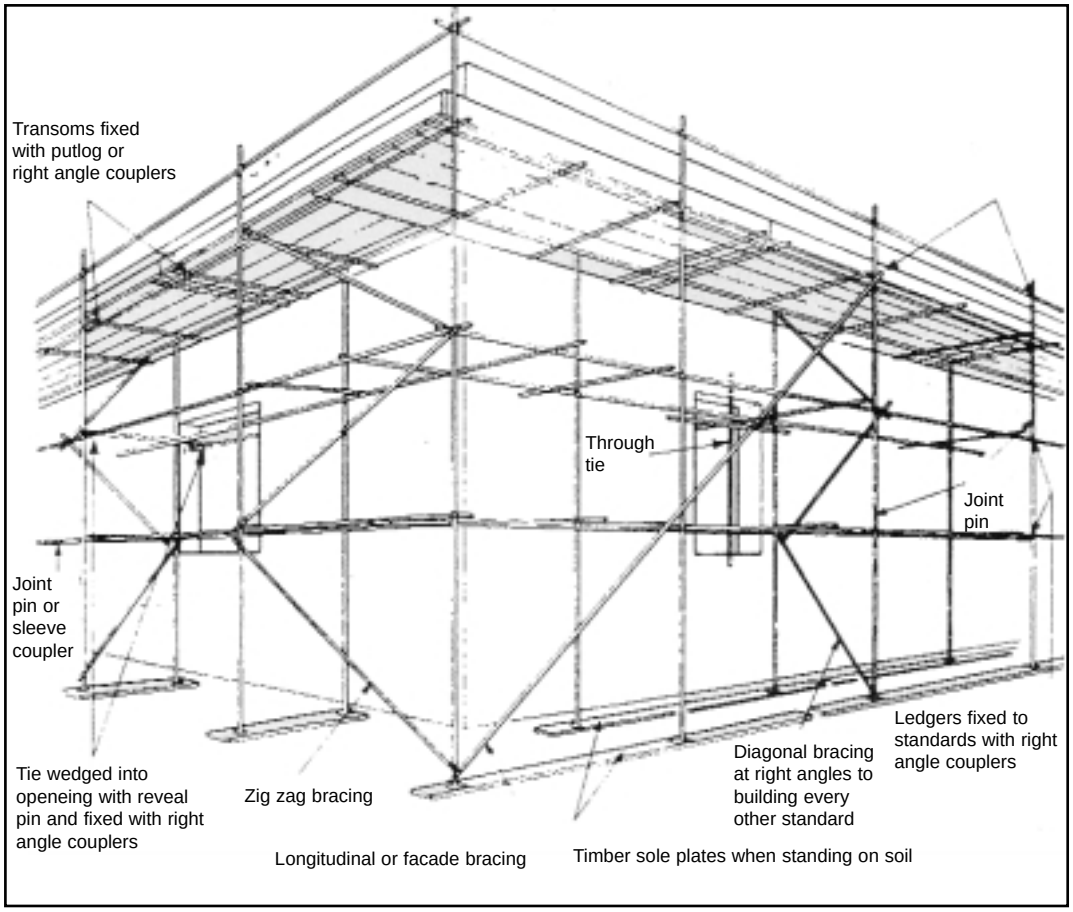
• Brick guards should be provided where stored materials can fall from a scaffold

• Warning notices must be displayed on scaffolds that are incomplete and access routes blocked

• Scaffolds should be inspected every seven days or after adverse weather conditions

• These inspections should be kept in a record (HSE F91A)





Final Tip

When scaffolding out a lock chamber or along a wall the standards should be set about 325mm from the wall to allow the use of a 225mm board and give working clearance near the wall.

4. RECOMMENDED READING

"Safe Use of Ladders" HSE Construction Summary Sheets SS2 (rev)
"Your Body at Risk" HSE Construction Summary Sheets SS28-35
HSE Books
PO Box 1999
Sudbury
Suffolk
C010 6FS

"Access Scaffolding" by C J Wilshere
Thomas Telford Ltd
ISBN 0 7277 0090 1

"General Access Scaffolds" HSE Construction Summary Sheet SS3 (rev)
"Tower Scaffolds" HSE Construction Summary Sheet SS10
HSE Books
PO Box 1999
Sudbury
Suffolk
C010 6FS

Scaffolding Record F91(A)
HMSO
Any Local HMSO Bookshop

Practical Restoration Handbook

Brickwork

by

John Park Adv. CGLI

CONTENTS

MORTAR MIXES
BASIC INGREDIENTS OF MORTAR

Building Sand

1. This is usually excavated from open cast pits hence the name usually given to this type of sand is pit sand, it should be free of clay and loam. It should never be obtained from the seashore as the sand would contain excessive amounts of salt which cause a white scum, known as efflorescence, to appear on the surface of the brickwork.

2. Pit sand is widely used and comes in a variety of colours e.g. red, brown, yellow, grey and silver.

3. The sand should contain fine small grains no larger than 0.5 to 1mm and it should not contain any large stones or grit because they would interfere with the laying of the bricks.

How to Store Sand

4. For long term use, find a suitable level site close to where you are going to use the material, with easy access for deliveries of sand and cement. Next lay a concrete base 3m by 3m by 100mm thick, then build a wall on three sides using either concrete blocks or old bricks about 1m high to retain the sand, use polythene or a tarpaulin to cover the sand to keep it dry and free from leaves, stones and frost.

5. For short term use have your supplier deliver the sand in 1 tonne bags which can be craned off the lorry to anywhere you need them. A deposit on the bag is usually required which is refunded when you return it.

Cement

6. Ordinary Portland Cement (OPC), sometimes known by brand-names such as Blue Circle and Rugby Cement, is the most commonly used cement for brickwork. It is made by burning a chalk and clay slurry in a rotary kiln about 90m long which produces a greyish clinker which is ground down to a fine powder, this powder is so fine it will pass through a sieve which has a mesh width of 90 microns. 100% passes 150 microns, 95% passes 75 microns.

7. Cement should be stored off the floor; ideally on a pallet and preferably inside a shed or container. If stored externally it should be carefully and tightly wrapped in tarpauline sheet which should extend under the pile of bags. Wrapping in tarpauline is also advisable when storing for long periods, even in sheds, since it prevents atmospheric moisture causing the cement to start to harden. Cement begins to set within 30 minutes of adding water with a gradual increase in strength which continues for at least two weeks. All mortar should be used within 2 hours of mixing and should never be remixed with water.

Lime

8. Lime was used before the introduction of cement, (which was not introduced until 1824 and even then it probably wasn't used because of the cost) so many of the canals built before this date were built using only sand and lime. Lime is produced from either chalk or limestone. When these materials are burnt at a very high temperature they turn into quicklime. The quicklime is not suitable for building with, so water is added to it , and this is called slaking. During slaking the quicklime produces heat and expands, and the water will integrate chemically with the quicklime changing it into hydrated lime. The setting times

depend on the impurities in the burnt lime. Active impurities in the lime render it independent of carbonation for its setting, and it is therefore capable of setting under water. This feature is named hydraulicity.

9. Non-hydraulic limes (rich limes) will not set under damp conditions. They set only by carbonation and develop little strength unless they are mixed with cement; this gives the mortar improved workability.

10. Semi-hydraulic limes, which will set partially under damp conditions, have a small amount of free lime (calcium oxide) and a percentage of hydraulic constituents, mainly derived from the clay content of the limestone. The slaking of this type of lime is much slower than that of a non - hydraulic lime. It is this which creates the action of setting; the hardening of the hydroxide being dependent on the carbon dioxide as in a rich lime.

11. Eminently hydraulic limes (which will set under damp conditions) are equivalent in chemical composition to portland cement, but contain a small amount of free lime. These limes do not harden so quickly as portland cement and do not reach such a high strength. Lime should be stored in the same way as cement.

Care must be taken at all times when handling cement and lime. Contact with wet cement or wet mortar may cause irritation, dermatitis or burns. Contact between cement powder and body fluids (e.g. sweat and eye fluids) may also cause irritation, dermatitis or burns. If cement comes into contact with eyes wash immediately with plenty of clean water and seek medical advice. If cement comes into contact with skin wash immediately with plenty of clean water.

Water

12. Preferably clean tap water should be used as canal water can contain impurities such as rotting plants and animals which can severely contaminate and discolour the mortar.

Plasticizers

13. These are a substitute for lime and when added to a mortar mix have the effect of entraining very small bubbles of air into the mortar and breaking down the surface tension, resulting in increased workability.

14. A 1:6 cement : sand mix with plasticizer is an alternative to a 1:1:6 cement : lime : sand mix. A plasticized mix weaker than 1:8 is not recommended.

15. Plasticizers may be used with sulphate resisting portland cements and with high alumina cement, and there is evidence that aerated mortars have greater resistance to sulphate attack than cement : lime : sand mortars of equal strength.

16. Evidence also shows that mortar plasticizers improve the resistance of freshly laid brickwork to frost. Mortar with plasticizer added can be either mixed by hand or mixed in a drum mixer, but prolonged mixing in a drum mixer can lead to excessive air entrapment which consequently leads to a weak mortar mix. Plasticizers can be obtained in liquid and powder form, but always read the information on the container for mixing instructions before using.

MORTARS FOR BRICKWORK

17. Requirements for mortar are as follows :-

    1. Good workability.

    2. Retention of plasticity long enough for bricks to be laid and adjusted, but stiffen within a reasonable time.

    3. Early development of strength.

    4. Mature strength should be adequate but no greater than is needed for the design, (mortar for a wall need be no stronger than the bricks).

    5. Adhere well to the bricks.

    6. Have adequate durability.

18. The final strength of the mortar used to build a wall has little effect on the actual strength or rigidity of the wall as might be supposed. A very strong mortar will centre any differential movement and produce fewer but wider cracks . A weak mortar will absorb small movements and produce hair line cracks in the joints.

19. As a result, mortar should only contain enough cement to attain adequate strength in the wall where it is being used, unless there is good reason for using a richer mortar i.e. in cold weather, where a richer mix attains strength more quickly to resist the effect of frost. When mixing mortar the sand and cement must be gauged out using a bucket or a small box so all the quantities are in the same proportion, this way every mix of mortar is the same strength and the colour of the mortar when dry is the same colour throughout the wall. Below is a useful table showing where mortar mixes are best suited and what time of year to use them.

MIX	USE	TIME OF YEAR
1C : 0 - 0.25 L : 3 S	Lock Chamber,top Cill Gate Recess Upper and Lower Wing Walls.	Winter
1C : 5S : P	Lock Chamber,top Cill Gate Recess, Upper and Lower Wing Walls	Summer Winter
1C : 3 - 4 S : P	Free Standing Walls, Parapets Etc.	Winter
1C :1L : 5 - 6 S	Free Standing Walls, Parapets Etc.	Summer
1C : 0.50 L: 4S*	Bridge Abutments and Arch Etc.	Winter Summer

* Note: English Heritage Recommend 1C:2L:9S for such highly visible locations

Key to Table

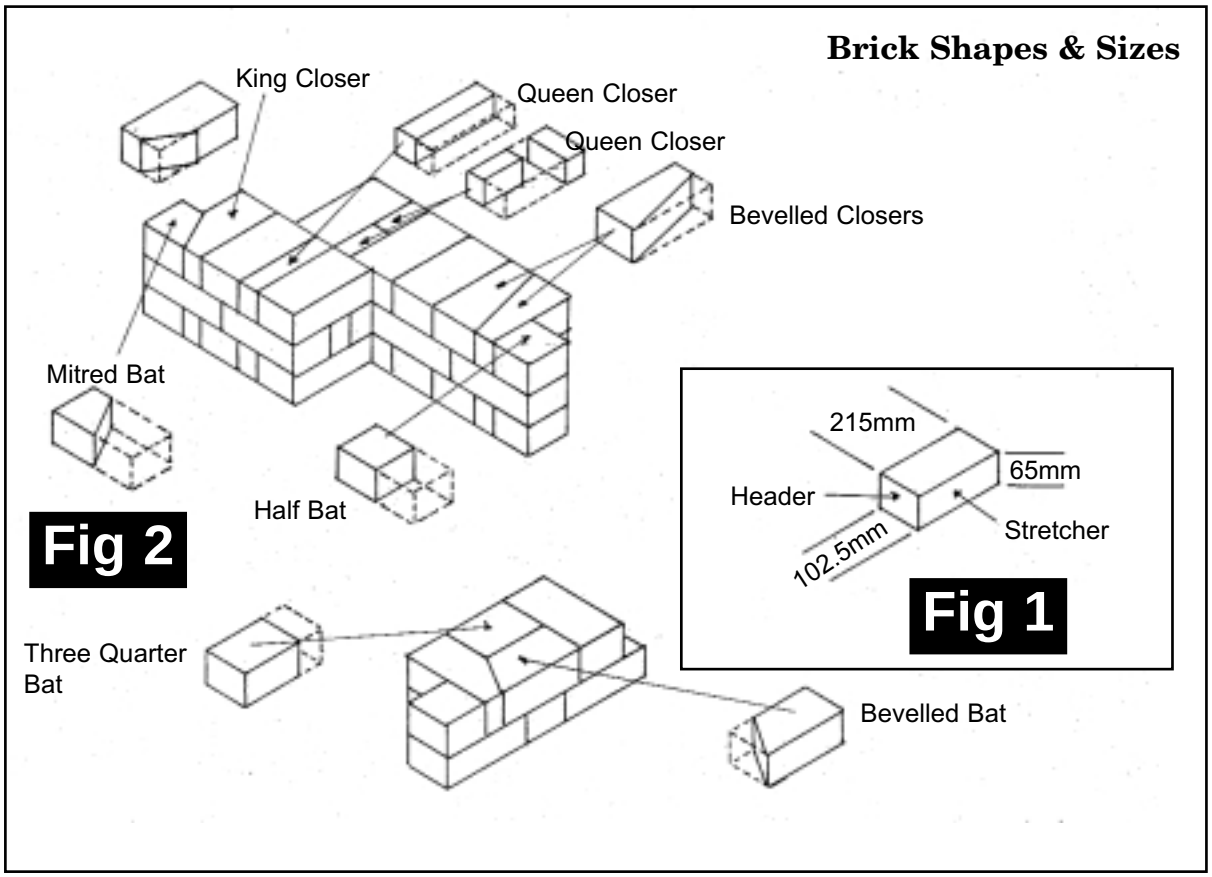
C : L : S = Cement : Lime : Sand.

C : S : P = Cement : Sand : Plasticizer.

BRICKS

Brick Shapes and Sizes

20. The nominal size of a brick is 215mm long, 102.5mm wide, 65mm high, *fig 1 (page 8)*. The average brick can be cut into eight different shapes to suit particular needs. They are as follows:-



A three-quarter bat which has a minimum size of 150mm long by 100mm wide

A half bat which has a minimum size of 100mm square

A queen closer which has a minimum size of 50mm wide by 215mm long. Closers which are 50mm wide by 100mm long

A king closer which has one corner cut off, a bevelled bat, mitred bat, bevelled closer. *See fig. 2*.

CLASSES OF BRICK

Engineering Bricks

21. Stock Bricks are made by machines pressing clay into moulds. Wire-cut bricks are made by machines forcing clay through a die to form an extrusion which is cut into slices (bricks) by a wire.

22. Engineering Class A bricks are impervious to water and are very hard and smooth to the touch. Their compressive strength is greater than 70N/mm^2 and their absorbtivity less than 4.5% by mass. They are

used where high strength, hardness, and moisture - resisting features are needed i.e. bridges, tunnels, retaining walls, damp - proof courses, load bearing piers, footings and manholes. Staffordshire blues are the most frequently used bricks on canals, the usual weight of these bricks is between 3.6 kg to 4.5 kg

23. It is advisable to use a stiff mortar when laying this type of brick as they tend to 'swim' because they do not soak up any moisture from the mortar. Another tip is to cover the face of the brick with oil or diesel before laying to keep the faces free of mortar smears. To assist in laying the bricks they need to be kept off the ground and covered well with tarpauline.

24. Engineering Class B bricks are not as strong as Class A. Their minimum compressive strength is 50N/mm^2 and their absorbtivity less than 7% by mass. They usually have either holes or indentations in the bricks to i.e. make the brick lighter and to form a key for the mortar. A useful tip when using these bricks. If the holes are full of water use cement powder to carefully fill the holes to soak up the water and then you don't get any horrible mortar streaks down the face of the brickwork when you start laying.

Special Bricks

Bullnose

25. These are used where rounded edges are needed i.e. top or bottom gate recesses, quadrants,small arches over bywashes and brick built bridges. In addition to the single and double bullnose there are various special use types as illustrated in *fig 3 (page 8)*.

BRICKLAYING IN COLD WEATHER

26. Brickwork which is damaged by frost is usually attributed to unsuitable mortar, wet bricks or bricklaying in freezing temperatures, it is unwise to lay bricks when the temperature is at or below 3^{o}C. Make sure when laying bricks that the temperature is at least 4^{o}C and rising when laid and afterwards keep the work covered for 48 hours, or longer if it is snowing, to keep it above freezing.

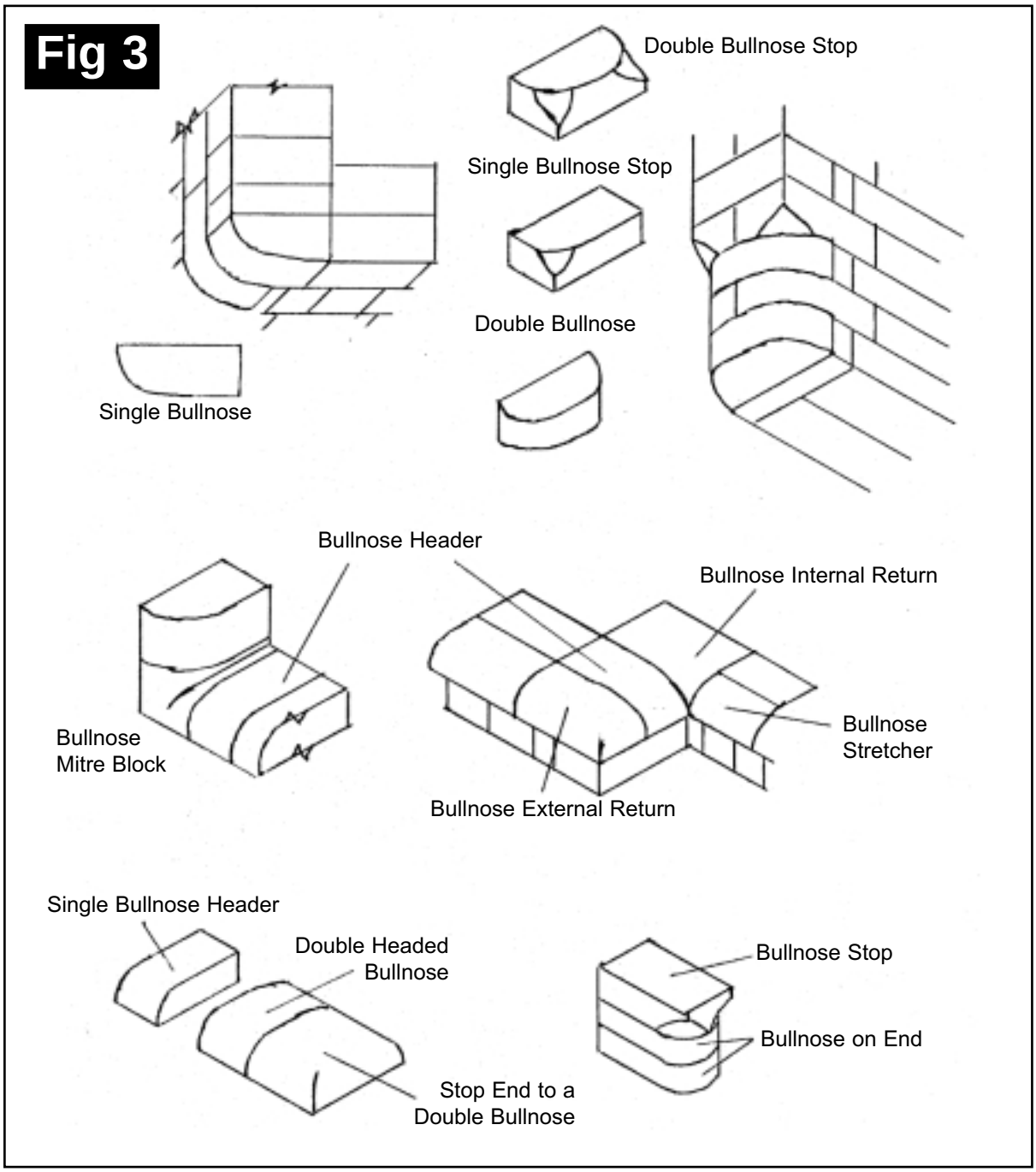
Effects of Frost

27. Water in the mortar expands on freezing disrupting the bond and causes cracks to appear in the joints. Likewise if you use wet bricks the frost can cause the face of the bricks and mortar to flake. The end result is a loss of strength in the wall.

28. Cement sets more slowly in cold weather (roughly half as fast for every 10^{o}C fall). If it rains when the mortar hasn't set, the rain can wash out the mortar from the joints and discolour the rest of the brickwork. All of these eventualities can be overcome by a bit of forethought in using a mortar mix suitable for cold weather and by keeping all materials, working areas and completed work covered up.

Protecting Materials from Frost

29. Bricks should be kept clear of the ground, preferably on wooden pallets and completely covered with tarpaulin. Sand should be covered immediately it is delivered with a tarpaulin. Cement should be stored off the ground preferably in a shed or a container.



Protecting Working Areas from the Weather

30. Working areas can be covered using polythene or clear tarpaulins to protect the bricklayer from the weather and to increase output, this is done by erecting a temporary scaffolding frame around the work area and covering this with the polythene or tarpaulin fixed to the frame.

Protecting New Brickwork

31. Freshly laid brickwork should be thoroughly covered with hessian to protect it from frost first then polythene in case of snow. If new work is to be left for a long period keep it well covered until the weather breaks.

Points to Remember

32. 1. Keep an eye on the weather and listen to weather reports.

2. Use a thermometer placed in the shade to get accurate readings of the daytime temperature.

3. All new work should be covered with hessian and polythene.

4. All materials should be kept covered at all times with tarpaulin.

5. When bricklaying in windy conditions check on the wind chill. This can have disastrous effects on brickwork, with even mortar on the trowel starting to freeze.

TOOLS

Brick Trowel

33. This tool is in constant use by the bricklayer, and varies in size from 225mm to 350mm. For a beginner a small trowel would be more suitable. Its main use is for picking up mortar and spreading it on the wall and on the ends of bricks to form perp joints, (perp = perpendicular) and for trimming the surplus mortar from the joints of previously laid bricks. The trowel can also be used for rough cutting soft bricks where they won't be seen.

34. The trowels can be obtained in both left and right handed versions, the right handed type being the most common. A right handed trowel is identified by the rounded edge of the blade being on the right hand side of the trowel with the handle nearest to you and vice - versa for a left handed trowel. The round edge of the blade is used for cutting bricks and the straight edge is used for trimming the excess mortar from the joints, *fig 4*.

A RIGHT-HANDED BRICK TROWEL

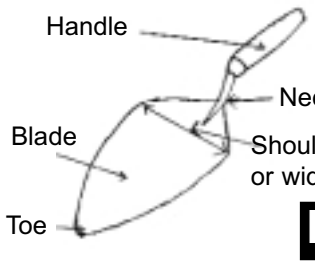


Fig 4

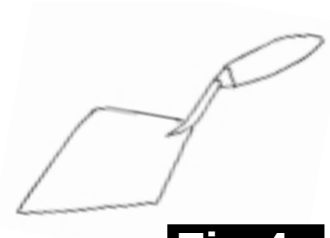


Fig 4a

Pointing Trowel

35. These range in size from 75mm to 150mm, and are the same shape as the brick trowel but without the cutting edge. They are used for pointing and jointing, an ideal size to aqquire would be a trowel size of 100mm, *fig 4a*.

Club Hammer

CLUB HAMMER OR
LUMP HAMMER

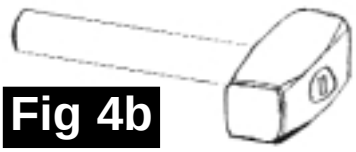


Fig 4b

36. Also known as a lump hammer, it can be obtained in various weights from 1kg to 2kg. It is best to buy a fairly light one as a heavier type would be tiring to use. The hammer is used for striking cold chisels and bolsters. The edges of the face should be chamfered, so if you miss the tool you are striking your hand will not be seriously injured. It is essential if you are doing a lot of cutting to wear gloves and eye protection, *fig 4b*.

Bolster

37. Also known as a boaster it is used for cutting bricks accurately and cleanly, it can be found in various sizes from 50mm to 100mm wide and should be made from good quality steel. A100mm wide bolster is a recommended size to purchase, especially when you have a large quantity of half bats to cut as you won't need to keep measuring them, *fig 4c*.

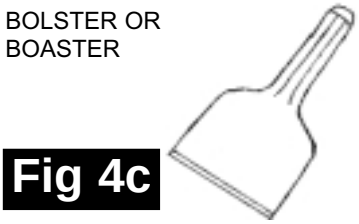


Fig 4c

Plugging Chisel

38. Is a long thin tool of about 240mm long with a flat narrow blade about 120mm long which is ideal for cutting out joints from around bricks when preparing to tie into old brickwork or for just cutting out one brick, *fig 4d*. This tool should also be made from good quality steel. It is best to keep a keen edge on all chisels or bolsters so when cutting bricks you will get a clean cut, and also keep the tops of the chisels and bolsters trimmed to prevent the heads from mushrooming with the danger of bits flying off when struck. For this you will need to use a bench grinder.

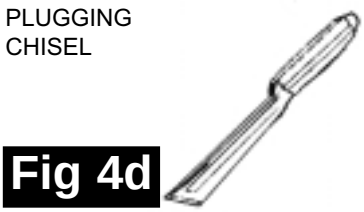


Fig 4d

Brick Hammer or Comb Hammer

39. A brick hammer has a square flat face at one end with a long narrow and slightly curved blade at the other end. The narrow blade is used for trimming bricks which have been cut with a hammer and bolster or for cutting bricks which are too hard to cut with the trowel, *fig 4e*.

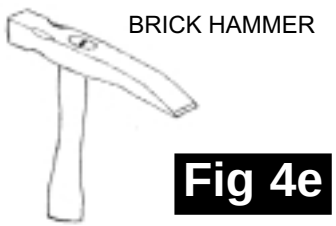


Fig 4e

40. A comb hammer has two identical arms each one having a slot into which can be slotted replaceable blades or combs which are very cheap to purchase. Can be used for the same purpose as the brick hammer with the added benefit of replaceable blades or combs.

Spirit Level

41. These range in size from 600mm up to 1800mm, a useful size to have is 1200mm. The level should have three vials altogether, one for levelling horizontal work, the other two for levelling vertical work. There also levels which have adjustable vials which are very useful for plumbing angled brickwork or plumbing the batter on a lock chamber wall. (A vial is a bubble tube). Modern levels are made from aluminium which makes them light and easy to use, *fig 5 (page 14)*.

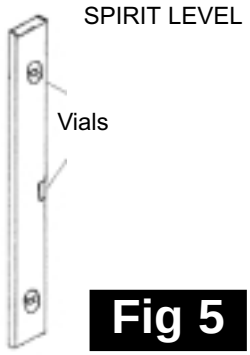


Fig 5

Boat Level

42. Also known as a torpedo level, they are usually 225mm in length with one vial for vertical and one for horizontal work. They can be made from wood, plastic or aluminium and are used for levelling one brick at a time, *fig 5a*.

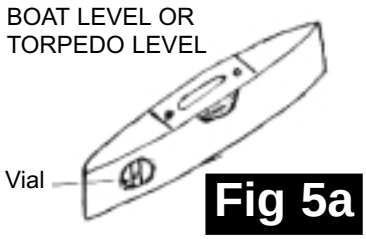


Fig 5a

Line, Pins & Tingle Plate

BUILDERS LINE & PINS

Fig 5b

43. The line you should use must be strong and elastic, and roughly 36m in length or longer. Do not use the bright orange nylon string as it has no give in it.

44. The pins should be made from hardened steel so they won't bend the first time you knock them into the wall, *fig 5b*.

TINGLE PLATE

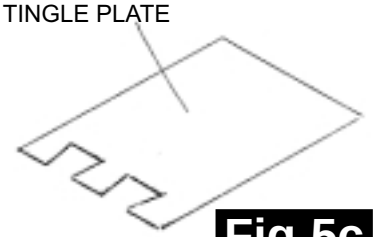


Fig 5c

45. A tingle plate is a flat piece of metal, 50mm by 100mm with two slots cut out of it on the short side so you can slide the line onto it. The idea is to set your line up at each end of the wall you are going to build. If you find after pulling the line as tight as you can it dips in the middle lay a level brick roughly in the centre of the wall, slide the tingle plate onto the line and rest the tingle on the brick weighted down with a loose brick and there you have one level line, *fig 5c*.

Tape Measure

46. Its best to have two tapes one about 3.5m long for measuring short distances and another tape about 30m long for all those extra long dimensions. Keep the tapes clean and workable by carrying a small oily rag and just run it up and down the tape now and again to keep them free from rust. Avoid dropping the steel tapes in water or mud as this will bring on rust with a vengeance and the tapes will be no good. You can buy long tapes of reinforced plastic or fabric.

Jointers

JOINTER OR RUBBING IN IRON

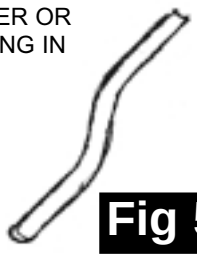


Fig 5d

47. Also known as a rubbing in iron, these can either be brought ready made or you can use an old bucket handle from a metal bucket or a length of rubber hose. They make a smooth inverted joint, *fig 5d*.

Bat & Closer Gauge

BAT & CLOSER GAUGE

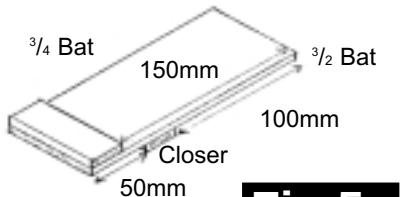


Fig 5e

48. To save time measuring closer's, half bats and three quarter bats this gauge is ideal To make the gauge all you need is a piece of hardwood i.e. oak, about 180mm long by 65mm wide by 10 or 15mm thick, two smaller strips of wood about 30mm by 65mm by 10 or 15mm and some panel pins. Now mark on one side of the piece of wood 100mm from one end this is for the half bat, then fix one small strip the other side of the mark that will be one side done giving you a gauge for a closer and a half bat. Next you fix the last strip of wood to the underside of the gauge at one end this is for the three - quarter cut thus making yourself a useful tool. The measurements used in making the gauge are the minimum sizes for the cuts, *fig 5e*

SMALL HAWK

Fig 5f

Small Hawk

49. These are readily available from most tool shops and are made of plastic, but they are easy to make; all you need is a piece of ply

150mm by 150mm by 10mm and a small length of broom handle about 150mm long by 25mm diameter nailed to it centrally.

50. The hawk is generally used for repointing, by placing a small amount of mortar onto the hawk and using a pointing trowel you can guide small amounts of mortar into the empty brickwork joints, *fig 5f*.

Brush

51. It can be a hand brush or a broom head with medium to soft bristles. Never use a brush with stiff nylon bristles. The purpose of the brush is to brush the finished brickwork down after jointing, to remove any loose mortar from the face of the brickwork. It can also be used for clearing loose material off existing brickwork when preparing the surface for laying.

52. It is a good idea to keep all your tools clean and serviceable, this way they last a long time. Articles needed for this purpose are an oily rag, small piece of soft brick, wire brush and some brick acid better known as masonrycleaner. The oily rag is used for cleaning your tapes and keeping your trowel free from rust when not in use. The piece of soft brick is used when cleaning your trowel after use, wet the brick and rub it all over the blade of the trowel then wash it off with water. The wire brush is used to keep your level clean, and is used in conjunction with the acid to keep all your metallic tools clean if they become heavily deposited with mortar. ALWAYS USE GLOVES AND EYE PROTECTION WHEN USING ANY KIND OF ACID.

POINTING

Preparation

53. First remove any vegetation off the face of the wall and from the joints, then the old mortar must be chiseled out by using either a plugging chisel and club hammer or a mini angle-grinder to a depth of at least 13mm.

54. The next stage is to wash the wall down using a pressure - washer, making sure all the soil, loose mortar etc. is washed away, (always wear goggles and waterproof gear when using a pressure - washer).

55. After pressure-washing, the wall should be left to dry out for at least 24 hours before repointing. Then the wall will need to be moistened with water to prevent moisture being drawn from the mortar, so that the wall is damp but not saturated, this will ensure good adhesion.

56. The mortar mix should ideally be 1 : 3 and fairly stiff so it doesn't slip off the trowel, tools needed for pointing are a pointing trowel and a hawk.

TYPES OF JOINTS

Weather Struck Joint

57. This type of joint is suitable where the edges of the bricks have become un-even due to weathering. The actual joint is formed by filling the empty perp joints first then the bed joints with mortar (perp = perpendicular), then place the pointing trowel on the perp joint slightly angling it and draw the trowel downwards producing a smooth surface. After all the perp joints are finished. The bed joints can be filled,

place the trowel on the bed joint with a slight angle, and then press hard on the joint while moving the trowel along the bed joint to produce a smooth angled finish, see *fig 6a*.

Weather Struck and Cut Pointing

58. This type of joint is similar to the weather struck joint, but the perp joints are neatly trimmed using a pointing trowel and the bed joints are trimmed using either a pointing trowel or a Frenchman, see *fig 6b*.

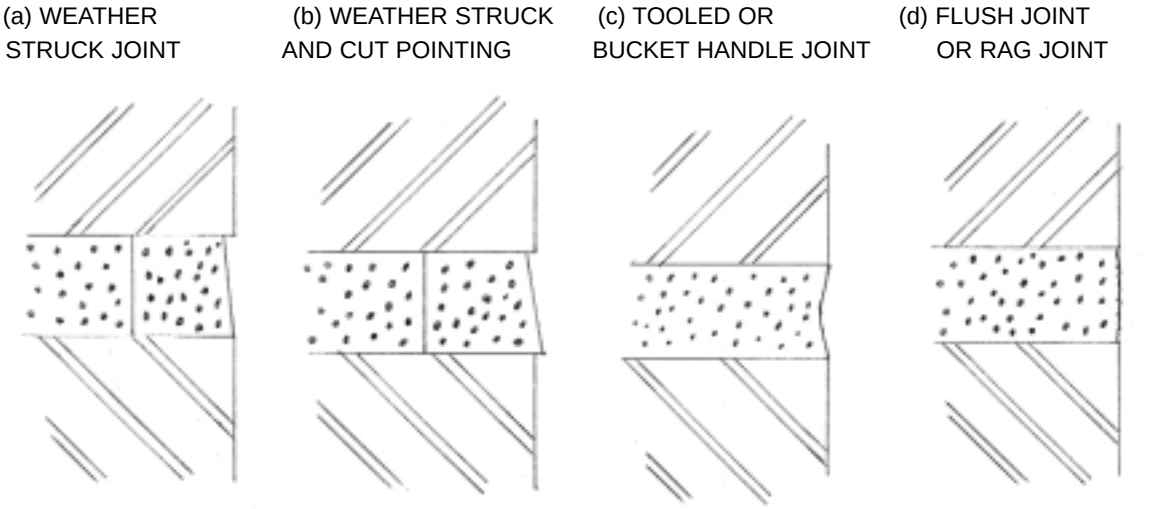


Fig 6

59. A Frenchman is a home made tool, all you need is an old table knife, cut the end to form a point and sharpen it, then heat the point and bend it 90^{o}, this should be used with a straight edge or a level, see *fig 6e*.

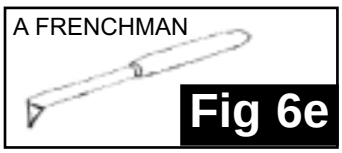


Fig 6e

Tooled or Bucket Handle Joint

60. This is the most widely used joint finish used today, and is quick and easy to do. Whenever donning up (slang term for jointing up) never press too hard as this will make the joint too deep, a nice shallow joint will be sufficient. The tool you use to make this joint can be anything tubular i.e. a rubber hose, an old type bucket handle or a piece of 10 or 12mm copper tube or a purpose made tool can be purchased to achieve this finish *fig 6c*.

Flush or Rag Joint

61. This type of joint should only be used above water level - the joint has not been sealed as in other joint types. The joint has a rough appearance and is made by rubbing a piece of rag or hessian along the joint, see *fig 6d (page 19).*

THE BONDING OF BRICKS

Bond

62. This is the sequence headers or stretchers in a wall to give a necessary pattern while retaining a satisfactory over lap.

Purposes of Bond

63. 1. To provide adequate strength and to guarantee that any load bearing on the wall is spread over the entire length and thickness of the wall.

2. To safeguard lateral stability and resist side thrust.

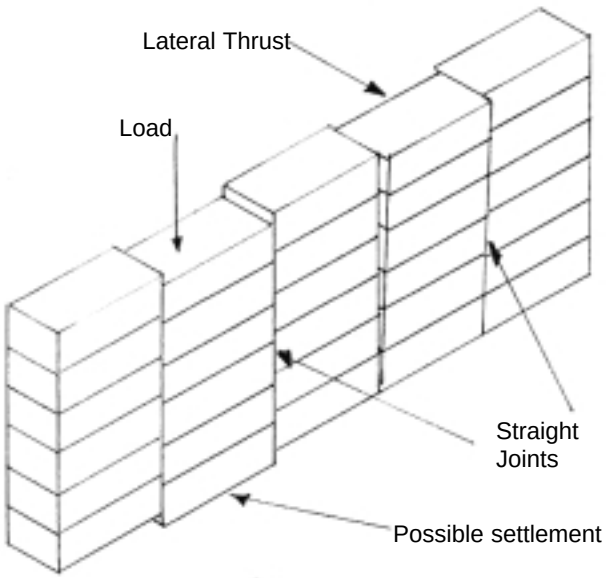
3. To give a pleasing effect to the overall presentation of the wall.

64. An unbonded wall is comparatively weak and liable to fail under a load or lateral thrust imposed upon it see *fig 7*. When the wall is bonded any load which is carried is distributed over the whole wall and there is greater resistance to side thrust, see *fig 7a*.

Rules of Bonding

65. 1. When setting out a wall it doesn't make any difference what thickness of the wall is so long as you make sure there are no straight joints internallyor externally, see *figs 8 and 9 (page 22)*. If you are using reclaimed imperial bricks for patchwork or continuing an existing wall, all you do is follow the bond that is already there. When using old bricks you will have to sort them out into different

Fig 7



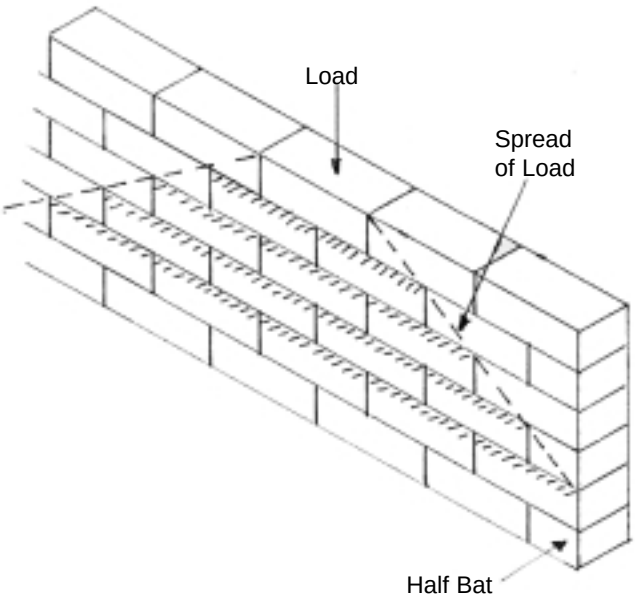
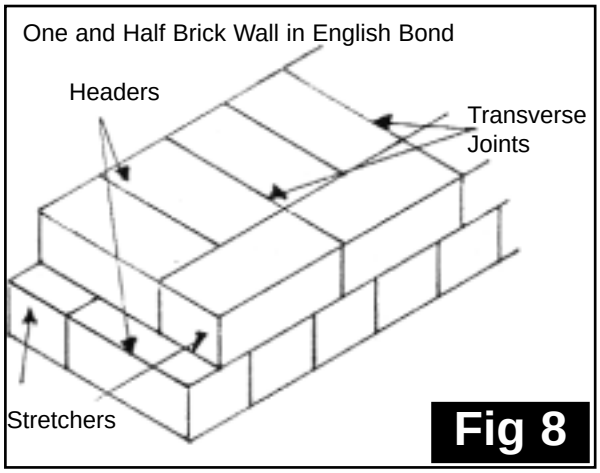
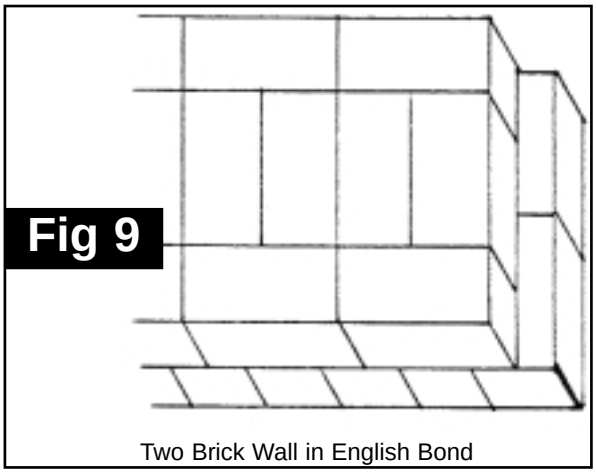
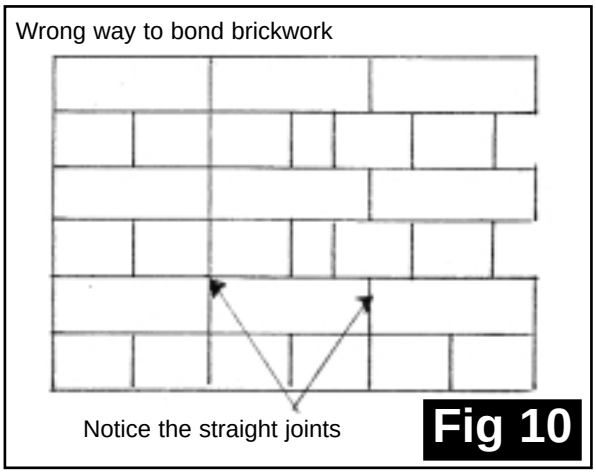


Fig 7a



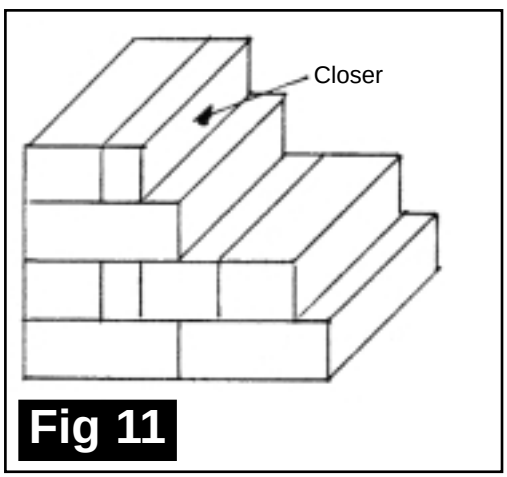


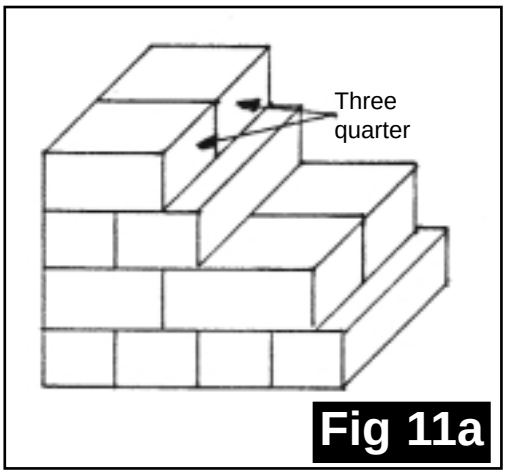
stacks i.e. large, small, headers, stretchers and badly chipped ones which can always be used in the back of the wall. Always remember when laying old bricks keep the joints tight,because otherwise you will end up with straight joints, see *fig 10*.



2. If for some reason you have to introduce a cut into the wall, (this applies when using new bricks as well as old) use either a half bat or one or two three quarter bats or a combination of the two, but NEVER EVER USE A CUT SMALLER THAN A HEADER IN THE MIDDLE OF A WALL, see *fig 10*, the only places where you would use a smaller cut is (i) at the ends of a wall where a closer is used next to a header to start the bond as in the case of English bond (see *fig. 11*) and (ii) where you have a ladder recess,or a ground paddle access hole where the bond also needs a closer next to the end header to maintain the bond or alternativly a three - quarter bat can be used on the stretcher course to start the bond see fig *11a*.

3. New bricks are slightly more difficult to use for patchwork as the two types of bricks are different sizes, the best way is not to use them at all for patchwork.





4. When using new bricks on an existing wall there is no way you will keep up with the existing bond, because all you will end up with is wide perp joints or several cuts in the wall which look very unsightly. The ideal way is to ignore what is below and start afresh, except where you are joining onto an existing wall, i.e. maintain the individual courses of headers and stretchers.

5. When setting out in English bond on a new wall i.e. a chamber wall with new bricks and a new concrete base or building off an existing wall you need to dry bond the first course, ideally using the header side of the brick to the front and spacing the bricks 10mm apart using a finger as a measure and also remembering to use a closer at the end of the wall to form the quarter bond, and also where a wall changes direction ie a ladder recess.

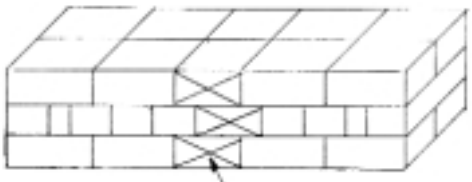


Fig 12

6. If the wall is such a length that a cut must be introduced, the cut must be placed in the middle of the wall this is known as broken bond, see *fig 12*.

7. When building a wall where part of the wall has to be left down, raking back is acceptable. (Raking back brickwork is when each subsequent course laid is a quarter brick or a three - quarter brick spaced back from the last course laid i.e. they form a step), see *fig 13 (page 24)*.

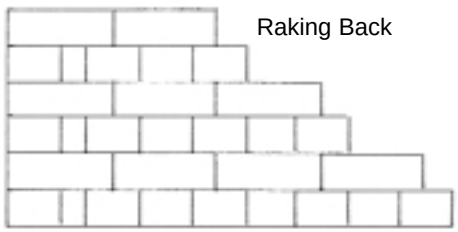


Fig 13

8. In the same situation as in "7" toothing is unacceptable, (toothing as the name suggests is when every other course is laid over hanging the last forming what I call a vertical zip joint which can lead to a weak point in the wall), see *fig 10 (page 22)*.

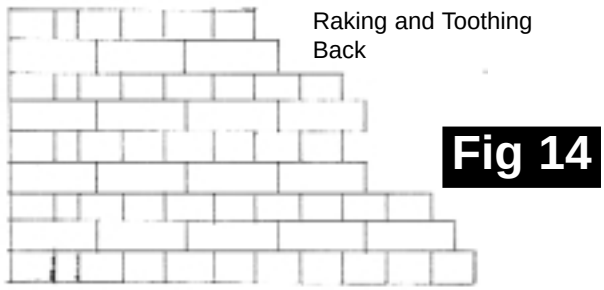


Fig 14

9. If you have the same problem as in "7", but need to leave a smaller gap a combination of raking back and toothing is acceptable, see *fig 14*.

BRICKWORK BONDS

English Bond

66. This bond has headers and stretchers in alternate courses, with a closer placed next to the quoin header to form the quarter lap (quoin = corner), or alternately a three -

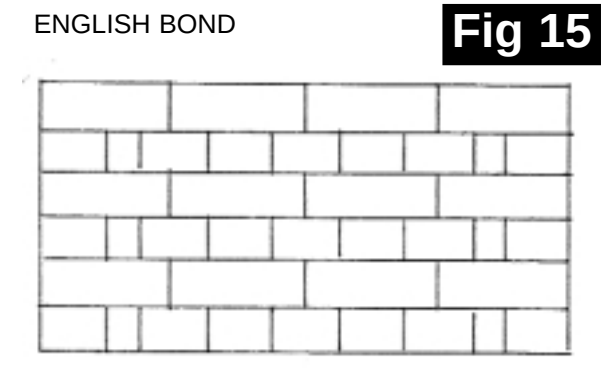
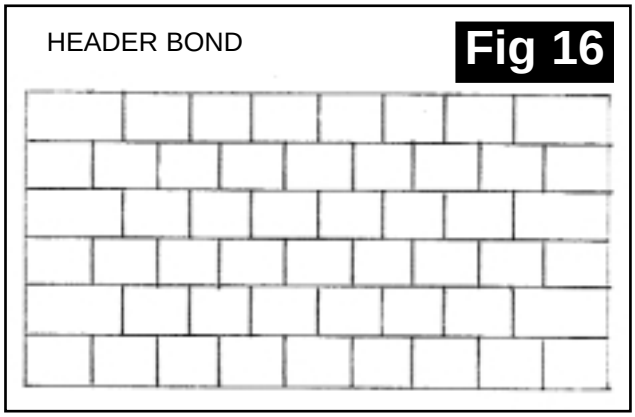


Fig 15

quarter bat can be placed at the quoin but only in the stretcher course. This is a very strong bond, with no straight joints appearing in any part of the wall. The face of the wall being monotonous to look at, it is used in walls where strength is preferable to appearance and always used in conjunction with engineering bricks, *fig 15*.

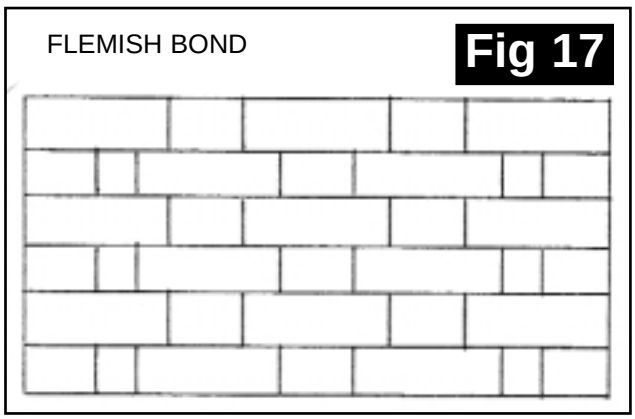


Header Bond

67. This is used in walls curved on plan. It consists of full bricks laid headerwise with a three - quarter bat on alternate courses or if you have a tight curve in a one brick thick wall you can use snapped headers on either side of the wall (snapped = half), *fig 16*.

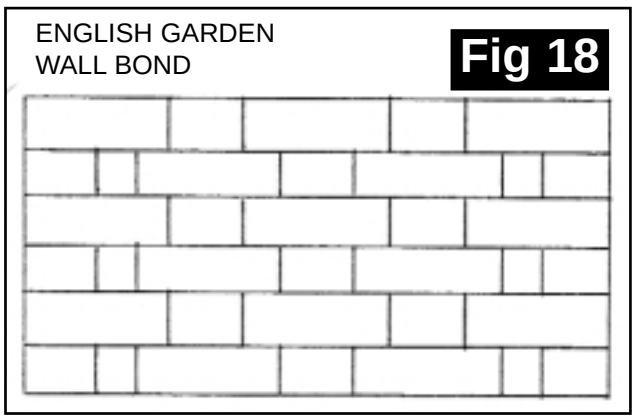
Flemish Bond

68. This consists of alternate headers and stretchers in the same course with the headers in one course being placed centrally over the stretcher in the course below. A closer is placed next to the quoin header to form the quarter brick lap. Flemish bond is used in walls of a decorative nature where strength is not important, as there are internal straight joints of a quarter - brick in length which appear at intervals along the wall, *fig 17*.



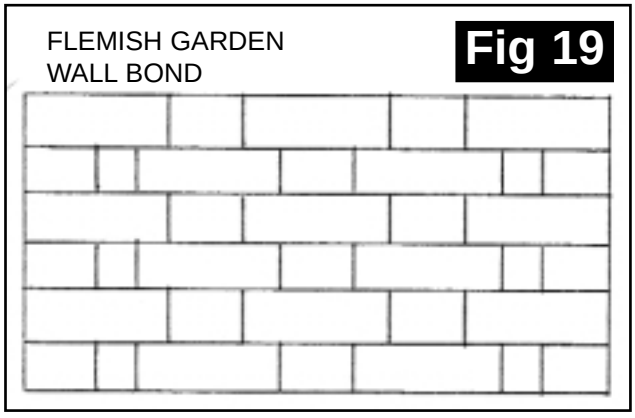
English Garden Wall Bond

69. This bond consists of three or five courses of stretchers to one header course, the stretcher course being laid half bond. It is mainly used as a one brick thick wall where a face side of neat brickwork is needed on both sides of the wall. An internal straight joint occurs throughout the entire length of the wall, *fig 18*.



Flemish Garden Wall Bond

70. This consists of three stretchers to one header in the same course. To maintain the bond, the header in one course must be in the centre of the middle stretcher in the courses above and below. Compared to English garden bond, Flemish garden bond is stronger as the headers are more evenly distributed, *fig 19*.



ARCHES

71. To use an arch to bridge an opening or a canal has a more pleasing effect than a concrete lintel or a concrete culvert. The term arch is taken from the word arc, which means part of the circumference of a circle. Arches have no need for any additional steel reinforcement like concrete lintels or concrete bridges, because the bricks are laid in such a way that with any load placed on the arch the stronger the arch will become.

72. Arches are usually organised into three main groups.

Rough Arches

73. In these arches the joints are wedge shaped not the bricks, these arches do not require such a high standard of finish. There is very little cutting if any, so the majority of canal accommodation bridges are in this group.

Fine Axed Arches

74. The word 'axed' in the above title means the bricks used in these arches are all cut to the same size and shape, and they are carefully worked out on a piece of marine ply which becomes the template for each brick. This type of arch is used in fine work where you can use either the same bricks as used in the normal face work or a brick which has a different colour or texture to make the arch stand out from the rest of the brickwork, *fig 20*.

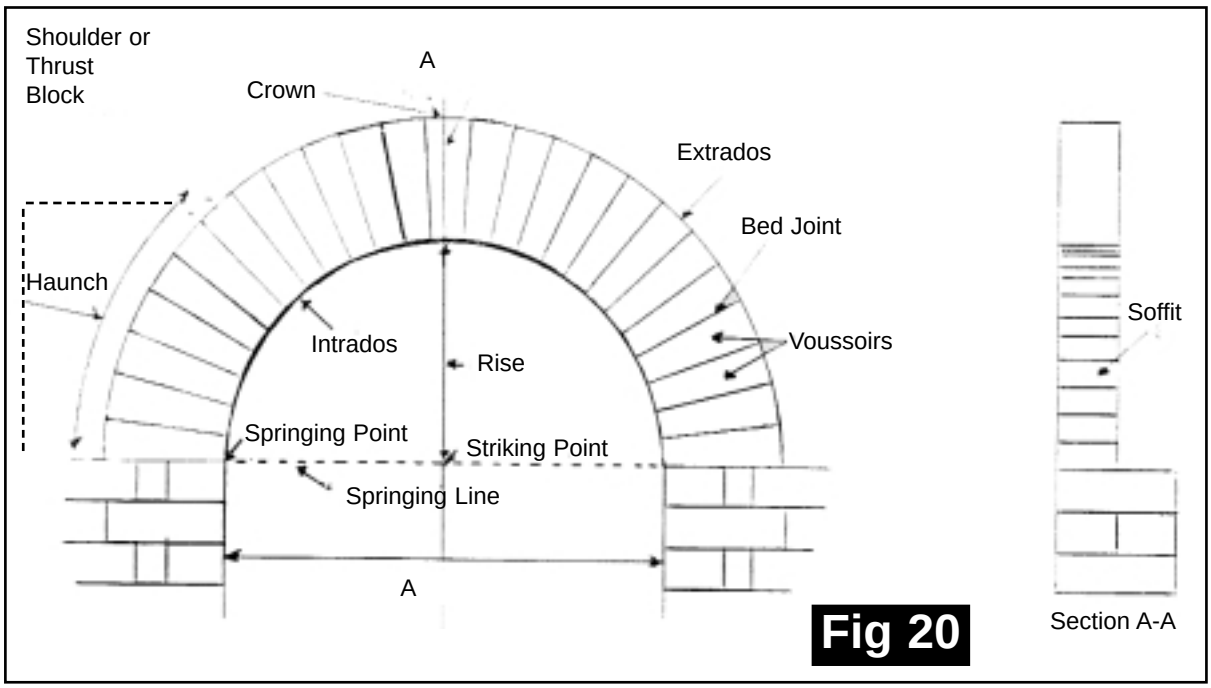


Fig 20

Gauged Arches

75. These arches are very fine and expensive so you won't find them on any canals, as the bricks need a lot of cutting and shaping. They are bedded using a very fine white powder mixed with cement, so the size of the joint will only be about 3 or 4mm.

Arch Terms

76. The following are the most frequently used terms in connection with building arches, see *fig 20*.

VOUSSOIRS are the bricks used in the arch.

SPAN is the distance between the two sides of the opening.

SOFFIT is the underside of the arch, see *fig 20* section A - A.

SPRINGING POINTS are the two lower points where the arch begins.

SPRINGING LINE is the horizontal line drawn through the springing points.

STRIKING POINT is the centre point of all arches, from which all voussoirs diverge from.

RISE is the distance between the springing line and the highest point of the soffit.

KEY BRICK is the last brick to be placed in the centre of the arch.

CROWN is the highest point of an arch where the key brick is placed.

INTRADOS is the underside edge of an arch when viewed in elevation.
The voussoirs for a rough arch are usually set out on the intrados.

EXTRADOS is the outer edge of the arch as viewed in elevation.
The voussoirs for fine axed and gauged arches are set out on the extrados.

HAUNCH is a name given to the part of the arch from the springing line to halfway to the crown.

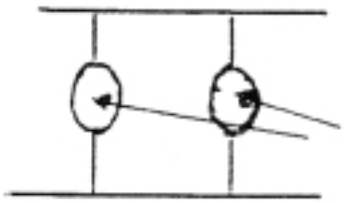
THE SHOULDER OR THRUST BLOCK is behind the haunch and is normally of brickwork or mortared random rubble.

BED JOINTS are the joints between the voussoirs.

JOGGLE JOINTS : in a few cases when cutting arches, after the voussoirs have been cut to shape, a deep groove is cut into all the bricks on both sides of the bed joint, *fig 22*, if they are soft bricks then you can use a coarse half round file. If you are using hard bricks then a comb hammer can be used. When all the voussoirs have been laid in the arch the joggle joint can be filled with a strong (1:1) cement /sand mix, *fig 23*.

JOGGLE JOINT FORMED IN A SOFT BRICK WITH A RASP

Fig 22



Joggle Joints filled with cement grout

PLAN

Fig 23

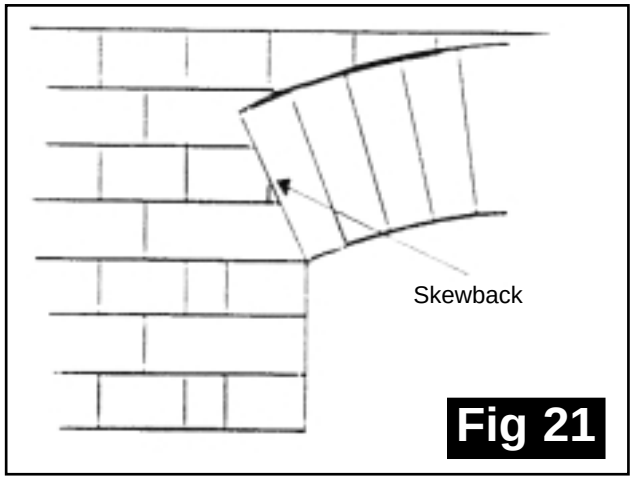
FACE JOINTS are the cross joints in bonded arches.

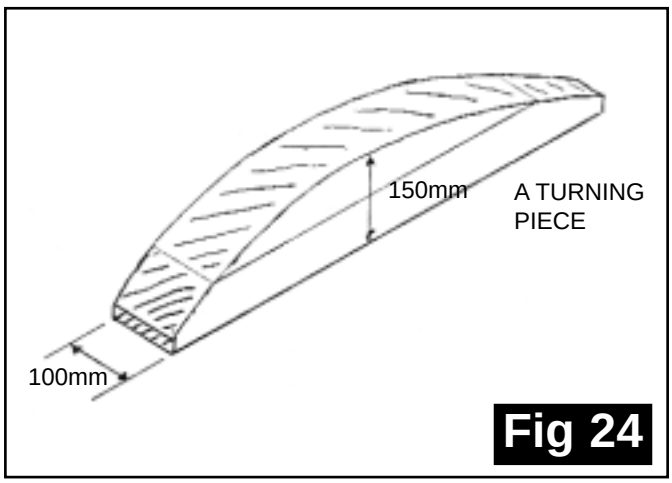
SKEWBACK is the sloping abutment from which an arch springs, *fig 21*.

How to Support Arches

77. 1. A turning piece is cut from two pieces of wood into the shape of the arch, this type of support is normally only used for segmental arches which only have a small span and rise, *fig 24*.

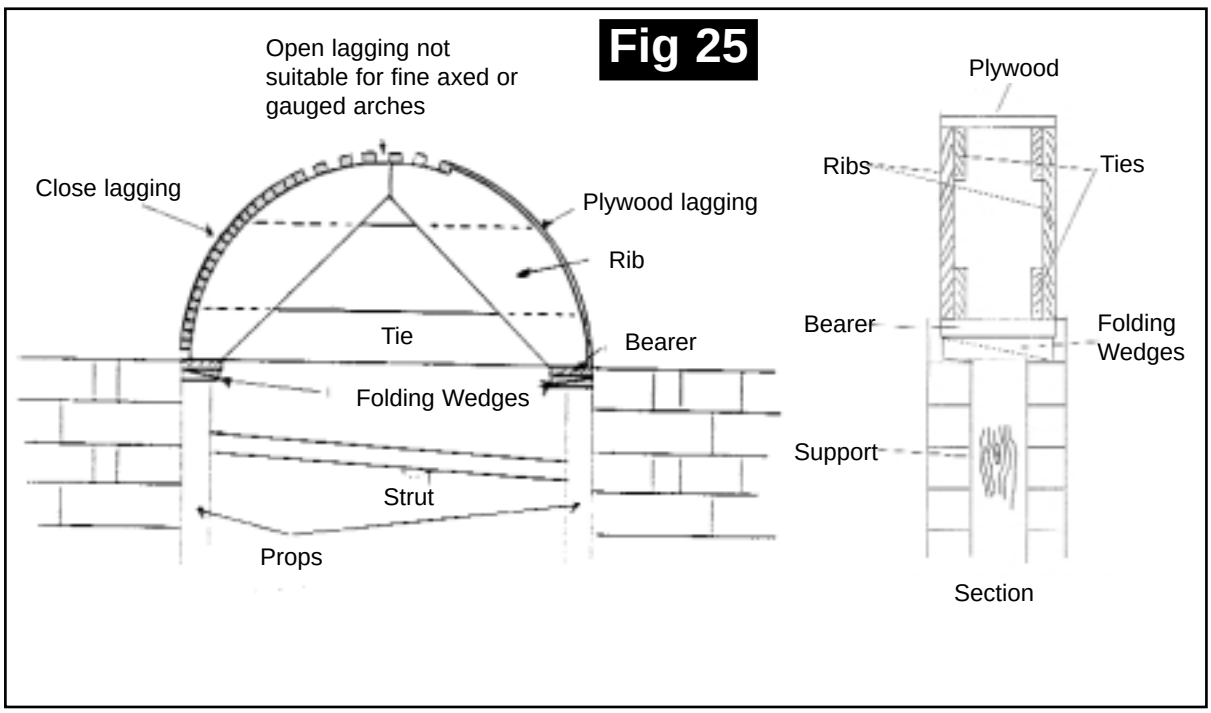
2. An arch centre or former is used in much the same way as the turning piece as a temporary support to carry the arch while it is being built. It can either have small - section timber members cut to the required shape close together or open, or when building an arch for a bridge you would use thin ply so you could easily form the curve. The advantage of using arch centres over turning pieces is the centre can be used over longer spans and for higher arches, *fig 25 (page 30)*.





Terms Used in Conjunction with Arch Centres

78. See *fig 25* and section.



RIBS are the semi - circular members which are used to make the shape of the arch.

TIES these are fixed across the lower and upper part of the centre to stop the ribs from spreading.

LAGGINGS are small pieces of wood which are fixed across the ribs to carry the voussoirs, they may be close or open - lagged.
Or alternatively you can use thin plywood of about 3 - 5mm nailed onto the ribs, this will provide a uniform surface to work on.

BEARERS are flat pieces of wood which are fixed underneath the ties to stop the ribs from coming apart.

PROPS are used to support the arch centre in the opening, two are usually required for a small arch.

STRUTS are used to keep the props in an upright position.

FOLDING WEDGES these are placed between the bearers and the props so that you are able to adjust the centre to the required height before starting the arch, and they make it easier to extract the centre after the arch is finished, four are usually required.

COPING STONES

79. Coping stones can vary in size from 300mm square up to 1.8m long by 900mm wide by 450mm thick. The copers (slang term) are usually dressed on two sides top and face side so they should be easily identifiable when they have been taken off the walls.

How to Remove Coping Stones

80. The first advisable thing to do is to erect a scaffold adjacent to where you are going to work i.e. in the lock chamber. You will then need to uncover the rear of the stones, when this has been done you may need a 110v demolition hammer and generator to remove any original early type of concrete holding the stones in place. In some cases the stones may be loose or even in the bottom of the lock chamber, so you might not need any demolition tools apart from a crow bar and a wrecking bar or a putlog.

81. When the stones are fairly loose, use the crow bar and wrecking bar together to get the wrecking bar as far under the stone as possible so at least two persons can prise the stone up so another person can put a half brick beneath it. Then two people can lift the stone towards them or the stone can be levered further. If the stones are to be removed a short distance away it is a good idea to paint some numbers on the undersides of the stones to help identify them at a later date. When removing stones everybody involved has to work as a team to avoid crushed hands or fingers.

How to Replace Coping Stones

82. Once all the brickwork has been completed and the wall has been back filled with concrete the copers can be cleaned down ready for relaying.

83. Start at one end lower the first coper down onto some bricks so you can easily manoeuvre it into position using the wrecking bar or putlog. If you stored the copers a distance away from the wall use some short scaffold tubes under the copers to manoeuvre them into position. When the coper is roughly in position lift the front edge up and place some pieces of broken tiles or similar to form a joint of about 25mm under the coper making sure the coper is level. Now you will have to lift the back of the coper up and place one

or two bricks underneath, depending on the shape of the coper whilst holding a level or a straight edge against the face of the wall so when the face side of the coper touches the level that is it. Now do the same the at the other end of the wall and fix a line between the two copers and start laying the remaining stones from one end to match the line. After all the copers have been replaced, concrete behind them and completely fill the gaps left between and under the stones with lean-mix. This is a fairly dry mix of 1 cement : 6 all-in 20mm Aggregate. Finally face-up the joints around the stones with a stiff 1 cement : 3 sand mortar mix, then using a pointing trowel draw it along the joints leaving a smooth finish**.** Then the area around the stones can be landscaped.

DETERMINING WALLS FOR DEMOLITION

84. If the external face of the wall looks all right this doesn't mean the wall is in a satisfactory condition internally. There could be voids or, in some cases where the half brick face of the wall has been rebuilt at some earlier date and not tied back to the main wall, then it could possibly fall away.

85. To check the wall for possible voids tap the wall with a club hammer to see if there is any sounds of a hollow ring. Other possible signs to look for are cracks either horizontal or vertical, or if you look length ways down the wall and see the wall leaning out from the top or bulging in various places then the wall needs to be demolished; how far depends upon the state of the wall near the bottom. In some cases the lower part of the wall which was protected by either mud or water can sometimes be left as it has been protected against the ravages of the weather.

86. The majority of locks I have worked on, have at one time or another had the front face of the chamber walls replaced with a new skin of brickwork from about lower water level upwards. They are easily identifiably by the different type of brick used compared to the original and the mortar would be harder because it contained cement.

DEMOLISHING WALLS AND CUTTING OUT BRICK TIE-INS

87. First erect scaffolding along the entire length of the wall which is to be demolished, then take off all the coping stones. Proceed to take the wall down to a firm base using demolition hammers. You will need to allow 460mm from the face to the rear of the wall to allow for a new double skin of brickwork measuring 215mm and 245mm of concrete backfill.

88. To tie the new brickwork back to the original brickwork, there are various methods available. The first one being the cheapest is to cut out 225mm square by 225mm deep pockets arranged in a diamond configuration thoughout the entire wall. These pockets would be completely filled with brickwork as and when the new wall reaches them tying the new wall to the old brickwork, then the void behind would be filled with vibrated concrete.

89. Another method is to drill holes into the existing brickwork to accept 10 or 12mm diameter " L" shaped reinforcing rods which you grout into the holes. The grout can be obtained from your local builders merchant in the form of epoxy resin and a dry powder which need to be mixed together thoroughly and used immediately. Then butterfly wall ties are built into the rear of the new wall, and some sheets of reinforcing mesh are placed between the new brickwork and old brickwork. Tie the wall ties to the mesh, and the mesh to the " L " shaped bars using tie wire and fill the void with vibrated concrete.

90. The last method is simply to use wall ties bedded into the rear of the new wall and tied to mesh and back filled with vibrated concrete.

91. The last two methods can only be used when the entire wall is demolished and the new wall is started off on a concrete base where the mesh is placed in the concrete before it sets.

92. When using any of the above mentioned methods it is advisable not to build a void more than six courses high before backfill since it can then be very difficult to clean soil and rubbish from the bottom of the pour. Such rubbish creates a zone of weakness which no amount of alternative reinforcement can compensate.

SETTING UP AND FIXING PROFILE BOARDS

93. Profile boards are used where there is a long stretch of wall to build i.e. a lock chamber wall. They should be of such a length to accommodate the entire height of the new wall and be straight and true, e.g. a scaffold board. They need to be fixed at the top and bottom, the top should be fixed to a length of timber at right angles to the profile and then this should be fixed to a post firmly knocked into the ground. Then another piece of timber should be fixed to the piece of timber which is at right angles to the profile and be diagonal to it, fixed to another post firmly knocked into the ground.The bottom of the profile should be temporally concreted to the bottom of the lock. The batter or backward slope on the wall is typically 1" in 40" or 25mm in 1015mm. To set the actual profile up, if you have only taken down the top half of the wall simply rest the narrow edge of the board against the wall and fix. If the whole wall has been taken down then you need to mark on your level 1015mm, place this on your profile vertically, adjust the level until it reads vertical and from the mark made on the level measure 25mm between level and profile and adjust profile to suit. It is always best to follow the original batter if possible (unless there is evidence that the wall has moved in the past). The original batter can be retained by erecting profiles before the original wall is demolished.

A GUIDE TO ESTIMATING QUANTITIES

MATERIALS

Bricks

94. Estimating brick quantities for English bond for example, are as follows.

There are 124 bricks to a square metre of English bond one brick thick including 5% for cutting / wastage.

95. So for a one brick thick wall in English bond 18m long by 3.450m high you would need 7,700 bricks.Calculate as follows :-

18m x 3.450m = 62.10 sq. metres x 124 = 7,700.

Mortar

96. On average between one and one and a half cubic metres of mortar are needed to lay two thousand five hundred bricks, depending upon the type of brick to be used e.g. if they are solid or if the bricks have holes which will take up a small percentage of mortar.

97. Calculating the amount of sand, lime and cement for a cubic metre of mortar can only be roughly estimated, as shrinkage occurs when water is added to dry materials.

98. It is widely accepted that one cubic metre of sand will make one cubic metre of mortar as the adding of lime or cement does not make any difference to the mass. So for a 1 : 3 mix you would require one cubic metre of sand, and a third of a cubic metre of cement and / or lime. For a mortar mix of 1 : 4 you would require one cubic metre of sand and a quarter of a cubic metre of cement and / or lime.

99. To calculate the actual amount of cement or lime for a 1 : 1 : 4 mix / one cubic metre of mortar, It is widely regarded that cement is equal to 1440kg per cubic metre and lime is equal to 722kg per cubic metre. So the following materials would be needed :-

1.00 cubic metre of sand.
0.25 x 1440kg of cement = 360kg
0.25 x 722kg of lime = 180kg.

A SIMPLE GUIDE TO BRICKLAYING

The Basics

100. To keep mortar off your hands it is best to wear a pair of gloves, not a thick pair but a thin pair of rubber gloves - the type you use for washing up.

101. The bricks should be stacked no more than 600mm away from the wall in a two by two stack to provide sufficient working space for the bricklayer. The mortar board (spot board) should be at least 600mm square.

102. The mortar board should be then placed on twelve bricks placed flat, three bricks at each corner so as to provide a convenient level to work off.

103. The mortar should be placed in the centre of the board so you can have plenty of room to pick up the mortar with your trowel. The method of picking up the mortar with your trowel is as follows:-

- Angle the blade so it is vertical then press it firmly down through the side of the mortar pile then draw it towards you moving the trowel in a back and forth direction to the side of the board.

- Then place the trowel flat on one side of the portion and with a quick movement slide the trowel under the mortar and pick it up. You must have enough mortar on the trowel to lay two bricks, if not it will take a long time to lay just a few bricks.

- To lay the mortar from the trowel to the wall, first position the trowel over where you want to put the mortar then with a quick flick of the wrist and a backward movement the mortar should land on

the wall, spread the mortar by using the point of the trowel and drag it along the wall forming a ‘ V ‘ groove in the mortar.

♦ Cut off any surplus mortar overhanging the edge of the wall with the straight edge of the trowel angled away from the wall so as not to smear the face of the other previously layed bricks, this mortar can either be used to form a perp joint on the bricks or can be discarded back to the mortar board.

HOW TO LAY A STRETCHER

104. Pick up a brick holding it in your left or right hand with your thumb on the stretcher face and your four fingers on the rear of the brick. Lay the brick on the mortar bed gently pushing the brick back and forth or if the mortar is fairly stiff tap the top of the brick with the blade of the trowel.

105. If you have a line set up you just push the brick down until it is level with the top of the line and parallel with the line. If you are laying free hand push the brick down and use a steel tape measure and check from the top of the brick to the underside of the joint that you have 75mm, the correct height for a metric brick.

106. When the brick is in position cut the surplus mortar from the bed joint and either wipe it onto the brick you have just laid or wipe it onto the end of the next brick you will lay, pick up the next brick and position it next to the previously layed brick pushing back and forth so as to squeeze the mortar in the perp joint to a uniform 10mm.

HOW TO LAY A HEADER

107. You will need to put mortar on the full thickness of the wall, then take hold of the brick with your hand with your thumb on one stretcher face and your four fingers on the other stretcher face. Lay the brick on the mortar bed with the header face towards the face of the wall. Push down on the brick with your hand and as mentioned before either use a tape measure to check the height of the brick or if you are using a line align the top of the brick with the top of the line and keep it parallel with the line. Take hold of the next brick with your hand as described above, holding the brick with your thumb nearest to you. Using the trowel in your other hand pick up some mortar with it and either wipe the mortar onto the side of the brick you have just laid, or wipe it onto the side of the brick in your hand either side of your thumb. Then place the brick next to the first brick and gently but firmly press the brick up against it and tap into position remembering to keep it parallel with the line and flush with the top of the line.

108. When building a wall in any bond you must always keep the vertical joints of the various alternate courses in line. If for some reason after you have laid a course of bricks some are dipping on the front edge just tap the back edge of the brick with your trowel so the front face of the brick is flush with the rest of the wall.

Practical Restoration Handbook

Concreting

by

Moore Flannery

CONTENTS

1. INTRODUCTION

1.1 Successful concreting relies on two things; firstly the concrete has to be the right specification for the job and secondly it has to be placed correctly. Handling concrete effectively and safely requires careful planning, preparation and, given the vagaries of weekend working in the British climate, not a little luck.

1.2 Concrete itself consists of a mixture of cement, large fines (usually 20mm aggregate but this is dependent on the application), small fines (usually building sand but this is also job specific) and water. The mix may have other admixtures added for special reasons (waterproofing, frost protection, colour, etc.).

1.3 A full analysis of the use of concrete would involve a complex mix of chemical, mechanical, structural and civil engineering and would certainly be beyond the scope of this document. This document aims to give advice to the Site leader to ensure that the issues associated with the handling of concrete on site are adequately addressed.

1.4 Particular reference is drawn to section 13 “Health and Safety issues”.

2. DESIGN OF MIX, REINFORCING, PLACEMENT, ETC.

2.1 Do not underestimate the importance of good design and specification of concrete structures. If at all possible seek advice from a suitable engineer (IWA has several Honorary Consultant Engineers who may be able to provide advice, contact IWA Head Office, 3 Norfolk Court, Norfolk Road, Rickmansworth, WD3 1LT for further details). On any project where there is input from a civil engineer or designer then the project plan should specify the mix and finish to be used (and probably its placement as well). These instructions should be followed and any deviations should be fully discussed with the engineer beforehand. Section 16 gives an example of the details given in a typical concrete structure design.

2.2 However, for simple jobs it is possible to select the appropriate mix to match the job requirements and site conditions by following a number of simple stages.

2.3 The overall job of describing what sort of concrete you want has been made easier by the introduction of designated mixes into the British Standard for concrete (BS 5328). Table 1 (page 6) gives illustrations of typical applications of designated mixes. In fact the job is often further simplified as these mixes are often further reduced to just a few standard mixes (page 6). However, it is important that a site leader can understand all the possible mixes he may be requested to work with and so the full details are given here.

2.4 To arrive at a specification for your mix a decision first has to be made as to which of the typical applications given matches your application and whether the concrete will be reinforced or not. Consideration must also be given to the ground conditions and the quality of the water the concrete will come into contact with. For most applications Ordinary Portland Cement (OPC) will be used however other cements exist for specialist applications such as high sulphate resistance (Sulfacrete), high initial strength (Ferrocrete), etc. Advice on a suitable choice can be obtained from the larger manufacturers of cements (Blue Circle, Rugby, etc.).

Table 1. (Standard mixes BS5328)

TYPICAL APPLICATION	DESIGNATION	SLUMP (mm)
FOUNDATIONS		
Blinding and mass concrete fill	GEN 1	75
Wall footings (non-aggressive soils)	GEN 1	75
Mass concrete foundations (non-aggressive soils)	GEN 1	75
Reinforced foundations in Class 1 sulphate conditions	RC 35	75
Foundations in Class 2 sulphate conditions	FND2	75
Foundations in Class 3 sulphate conditions	FND3	75
Foundations in Class 4A sulphate conditions	FND4A	75
Foundations in Class 4B sulphate conditions	FND4B	75
GENERAL APPLICATIONS		
Coping stone bedding, etc.	GEN 0	V. low (nom. 10)
Backfill to wall cavities	GEN 1	125
Solid filling under steps, irregular, awkward pours, etc.	GEN 1	75
SLABS AND BASES		
Bases with no reinforcing	GEN 1	75
Bases with reinforcing	RC 30	50
PAVING AND GROUND COVER		
Domestic parking and external paving	PAV 1	75
Heavy duty external paving	PAV 2	50

Note that a “Non aggressive soil” is taken to be Class 1 Sulphate conditions.

The RC designation refers to Reinforced Concrete and the figure after the RC refers to its strength (measured in Newtons) after 28 days curing. RC figures are often abbreviated to just C figures (i.e. RC30 becomes C30). This is perhaps the most commonly used method of specifying concrete and frequently the other categories are “respecified” to these figures. This is obviously a potentially dangerous technique however a brief guide would be:

Table 2. Simplified mixes

MIX	APPLICATION	MATERIALS for 1m3	AKA
C20	Blinding off, leanmix pours, etc.	250kg OPC, 0.5m3 Sand, 0.75m3 Agg.	
C30	Backfilling of walls and slabs with a high steel content.	300kg OPC, 0.5m3 Sand, 0.75m3 Agg.	6 to 1 mix
C35	Structural slabs still containing steel reinforcing	325kg OPC, 0.5m3, 0.75m3 Agg.	
C40	Concrete with a high resistance to ground conditions.	350kg OPC, 0.5m3 Sand, 0.75m3 Agg.	5 to 1 mix

Again, it cannot be stressed too highly that where a specification has been given it should not be adjusted or respecified without consulting the engineer.

3. READYMIX OR HANDMIX?

3.1 It may seem strange for a Canal Society to hand over its hard won cash to some other company to mix concrete when they can mix their own.

3.2 However the logic can be very persuasive: buying concrete readymixed may be more convenient, quicker and less wasteful (i.e. cheaper).

3.3 If you mix your own concrete, then you are responsible for ordering and storing the bulk ingredients (including clean water) and ensuring you have enough competent volunteers to mix AND place the concrete. By ordering from a readymix company the responsibility for all these factors rests with the company - often a definite advantage. There is, of course, an additional direct cost and a rough guide is that readymix usually costs about twice the price of the raw materials - but no split bags, expensive materials left over and far less mixing time meaning more time for your volunteers to spend on more skilled tasks such as bricklaying.

3.4 A logical extention of this argument may result in your project using precast concrete. Again this will have a financial penalty, however, for culverts and other such regular shaped constructions it is an option that is well worth considering. Companies such as FC Precast of Derby will give excellent advice and guidance in the installation techniques required.

3.5 If readymix is the chosen technique then the supplier should be given the mix designation, the required workability, the intended placement method and finish required. If the nominal maximum aggregate size is different from 20mm, this should be specified. Most readymix suppliers will give expert advice (and if they don't then don't use them). To make absolutely sure that the quality of concrete is going to be right, dealings should only be with suppliers who operate an independent assessed quality system, or from producers who hold third party product conformity certification. This will almost certainly remove the old requirement of having to provide a test cube (q.v.) when working with bodies such as British Waterways.

3.6 Remember that not all the responsibility would lie with the external company as you will still need to have an understanding of the stages involved, i.e. how to specify the mix required, accept delivery and work with the concrete.

3.7 "Handmix" is of course a red herring as, in the authors opinion, it is almost never sensible to mix without mechanical assistance. With the exception of a one off "emergency" mix to backfill a coping stone or similar it is just too tiring a process, quality control will be poor and your site will probably get very messy.

3.8 For the rest of this chapter it will be assumed that readymix is the chosen technique as it is here that most disasters occur, however most of the comments are equally relevant to handmixing.

4. PLANNING, PREPARATION AND TIMESCALES

4.1 It cannot be stressed too much that adequate preparation pays great dividends with concrete pours.

4.2 The first thing to realise is readymix manufacturers work an unfair system whereby you are charged for your mistakes but you have no comeback against their poor timekeeping. Once the load has arrived on site

you will be charged if you take more than 5 minutes (per cubic metre) to discharge it, however the wagon can turn up 2 hours late and you can claim nothing. Thus good planning and preparation is rewarded financially.

4.3 Well before the wagon turns up you should have checked you have an adequate supply of clean tools, tamping blocks, etc. Ensure that all sensitive areas (such as new or clean brickwork, scaffold clamps, etc.) are protected from splashes and that all barrow runs, etc. have been tested with a dummy load.

4.4 When planning the pour remember to allow time for cleaning up afterwards (especially easily forgotten items like wheelbarrow wheels). If using dumpers then be realistic about how long it's going to take to turn round each dumper run and warn the producer if it is going to be more than 20 minutes.

4.5 Always consider the whole curing time - if your pour is having fast running water kept off it by a pump then ensure that it will run until the concrete has gone off and that there is someone to keep an eye on it in case of blockage or breakdown. You may have sealed that underground spring but will the water pressure find another way out in the next 12 hours? (The answer to that one is "yes" and that's why it is always better to divert the water via a known route than try and stop it - contact your local WRG Smart Alec for further details.)

4.6 Unless you are absolutely sure you have the quantity of concrete exactly right always have a standby/overflow job to absorb any excess concrete delivered because if you send it back in the wagon then you will incur extra costs as they have to dispose of it. It is best to make it a simple job that will not absorb too many people or detract from the successful completion of the main job.

5. WORKABILITY OF CONCRETE

5.1 As soon as the concrete arrives on site, it needs to be inspected. Check the actual delivery ticket to ensure what has arrived is actually what you ordered (volume, grade, etc.). This is the only chance you get to send it back so it's worth doing no matter how much you trust the supplier. Having inspected the delivery ticket, you should then check the workability of the concrete to determine its suitability for placing. On an important job this would be a full slump test (q.v.), however on most sites it usually takes the form of a token load checked for "shovelability".

5.2 If testing indicates that the workability is below the lower limit, it is fine for the driver to add water to the load to increase the workability within specified tolerance, this is the usual case as the mix will leave the mixing plant a little drier than specified and water will be added by the driver on delivery.

5.3 However, if the concrete arrives and you find that its workability needs to be increased to assist placing then you can ask for water to be added. But note that if this is done then all liability for the properties of the concrete will be disclaimed by the producer.

5.4 If the concrete arrives and on site delays make it too stiff to use, then adding water is not the correct solution. A plasticiser admixture should be added for the concrete to reach its lowest possible water content, but still be suitable for placing.

5.5 Concrete can also arrive too wet due to excess water added at the mixing plant, though this is unusual. If this occurs, the concrete should not be used until the supplier has been contacted and the concrete's suitability has been checked.

6. ACCESS TO SITE

6.1 Always consider carefully the access and egress of the placement method. If it is to be directly unloaded from the wagon then check the wagon can safely and easily get into position. It is important to check the total weight and axle weight of the wagon against any site restrictions you may have. If it is to be transported by dumper then check the run is short enough to ensure the vibration does not segregate the mix. Equally important in poor weather or ground conditions is whether the dumper run will still be possible after the 7th pass. Some producers will offer a wagon with "conveyor belt delivery" as this "will allow easier placing of the mix" - the jury is still out on this option. Another option is the use of a concrete pump, though this too has generated some very fraught weekends. Pumping concrete is a very specialist technique that should be approved by the design engineer and the manufacturer should be made aware of the intention to pump as it will affect the mix required.

6.2 Don't forget that the wagon will be significantly lighter and therefore have much less traction over wet grass/mud on the way out. If it gets stuck on the way out they will still charge you waiting time. It's a bit touch and go as to whether you'll have to pay but seeing as it took you all week to track down a firm that would deliver on Saturday afternoon and would accept a Canal Society cheque can you really afford to upset them?

6.3 One final point regarding access; don't forget that you will need to finish off the surface. Wading through the concrete is not a safe option so always consider how your tamping crew will be able to get at the whole surface of the pour.

7. FORMWORK

7.1 All of the above will be of no consequence if the formwork itself is defective. This is the item most often hurried or bodged on a concrete pour as all too often the assumption is that shuttering (as formwork is more commonly known) can be knocked together from bits and pieces around the site. The main failing (literally) of concrete shuttering is not understanding just how much force a concrete pour hits the ground with or for that matter just how much weight is associated with a mix (especially if it is being vibrated). Remember that concrete weighs in at 2.4 tonnes per cubic metre and will be ejected from the back of the wagon at a height of 3 metres so it should not be too much of a shock that poorly erected shuttering often gets swept away. It's no use asking the wagon driver to go a bit slower - (s)he is in a hurry and is probably more worried about getting off site.

7.2 The second most common mistake is that not enough thought has been given to the removal of the shuttering. All too often people wedge shuttering against walls with bricks and then find it impossible to remove when the weight of the concrete pins the brick against the wall. Another common mistake is designing shuttering with lips, projections or nails that are then gripped by the concrete and become impossible to remove without damage to the face of the pour. Nails should always be on the outside of shuttering and should not be driven fully so that they can be removed easily.

7.3 You may wish to consider using a proper formwork system such as major contractors use - these are designed for large regular shaped pours. However it is much more likely that you will wish to get out your junior carpentry kit and customise an 8'x4' ply sheet.

7.4 Obviously the wood should be shuttering grade or better and it is strongly recommended that the internal faces of the shuttering are coated with a proprietary Mould Release Oil - this is good practice on simple shuttering and essential on any complex shuttering. Oiling the shuttering makes it easier to strike (with less chance of face damage), produces a better finish and allows the ply to be reused many times. It is possible to economise and use sunflower oil or similar but check that there will be no reaction with any admixtures in the mix. An alternative is covering the ply with visqueen sheeting but beware the effects of air bubbles and folds in the plastic getting caught in the pour and spoiling the face.

7.5 Any joints in the shuttering should be sealed otherwise the grout will leak out (especially if vibrated) leaving only the larger fines around the joint producing a distinctive honeycomb effect. This will result in weakness along an already vunerable edge. The traditional technique for sealing joints is to use strips of rolled up cement bag and if done carefully this can achieve acceptable results, however these days rolls of domestic draught excluder are cheap, easy to apply and produce much better results.

7.6 The finishing of faces is often specified in the design and is usually given a grade of either F1 and F2. Roughly speaking F1 is a smooth finish that is free of voids and air bubbles and it applies to exposed faces, etc. F2 corresponds to a rough trowelled or tamped finish suitable for laying bricks on. Other finishes are "brushed" and "wet brushed". The brush finish is used to provide a rough but regular surface whilst the wet brushed is a refinement of the technique whereby once the surface has undergone the first stages of curing a wet brush is used to wash away the surface grout leaving the larger fines exposed.

7.7 The final mistake made regarding shuttering is to strike it too early, if this is done then damage may occur not only as the shuttering is removed but also due to the concrete curing too quickly (see Section 9 Curing). The length of time that shuttering needs to be in place is obviously dependent on the mix and any admixtures but 18 hours should be viewed as a minimum for a normal mix.

8. PLACEMENT

8.1 If the ground you are placing the concrete on is at all boggy or you suspect it will move whilst the concrete goes off then it is usual to "blind off" the base of the pour. This means placing a supporting layer below the concrete that will support the concrete as it is placed, prevent loss of grout and also prevent contamination by ground conditions. To do this it must be stable and waterproof and this is usually achieved with a combination of these techniques:

- a geotextile layer (e.g. Bidim 444, Polyfelt 2000, Teram),
- a layer of hardcore, rubble, etc.,
- an initial pour of "leanmix" concrete that is poured and allowed to go off before the main pour.

8.2 The blinding should be included in the design specification as it is an important part of the pour and should be adhered to. Generally any blinding should be good enough to walk on, if not then it is not up to the job of supporting the pour.

8.3 Whether blinded off or not a concrete pour really does have to be a clean environment, when preparing an excavation always ensure that all edges and banks are stable and will not collapse during the placement. Ensure all organic matter is removed and any rubble, dust, etc. is removed.

8.4 Concrete needs to be placed so that it does not segregate and at a speed which allows it to be compacted properly. This is achieved through placing it in a series of layers. Then the concrete is vibrated to literally shake out the trapped air and encourage the mix to flow to all the extents of the formwork. The layers of concrete should not be too deep otherwise the weight of the material at the top makes it almost impossible, even with vibration, to compact the bottom layer. lf this happens, air will be trapped in the mix leaving voids and blow-holes that will result in surface blemishes and more importantly a loss of strength.

8.5 The maximum depth of these layers depends upon the method of compaction. Poker vibrators are the most suitable for canal restoration. The maximum depth of a layer should be 3-500mm dependent on the size of your poker head. Vibrating beams are an alternative but they are not as powerful and only good for regular shaped slab type pours (up to say 150mm.) The total lift height should not normally exceed 2m.

8.6 In all cases, a layer must be fully compacted before any more concrete is placed on top of it as voids in the lower concrete cannot be removed once the next layer is placed on top. However, the bottom layer still needs to be workable enough to respond to vibration so that the two layers can knit together without any joints, which is another reason for getting the material into position as quickly as possible.

8.7 The use of a vibrator will also allow the concrete to flow around coping stones or similar when backfilling thus providing a far better job. Petrol driven vibrators are undoubtedly the most popular but they are notoriously unreliable and it would be wise to ensure a second unit in reserve (or perhaps in a nearby hire shop), diesel models do exist which are slightly heavier and harder to start but more robust. It is also possible to get electric models which are much lighter but more susceptible to damage. Either way it is the poker head (a simple mechanical coupling and a Bowden cable that overheats) that is the unreliable part and this is unfortunately common to all of them.

8.8 Although a vibrator is always recommended, simple “non structural” pours can be placed without one simply by “chopping” along the pour with a shovel and working it in and out. This is much less effective than a vibrator - considerable and continuous effort is required but acceptable results can be acheived.

8.9 Always give considerable thought to how your reinforcing will be supported during the pour - steel rebar or mesh must be installed in accordance with the designers wishes. Chocking it up on half bricks and throwing the concrete around it is not really acceptable, various support systems exist for reinforcing and although they may seem more expensive than half bricks they will remove a common weak point in concrete pours - again, check with your designer.

8.10 Beware if you need to lay concrete to a slope - it is possible and depends on the workability of the concrete, however anything over 25 degrees from the horizontal is probably better built some other way.

8.11 Concrete can be placed under water but it must be done carefully to ensure that the fines are not washed away. Anything trickier than that (such as pouring a slab with water running across it) is in the realms of specialist professionals and you are probably trying to solve the problem the wrong way.

8.12 One final point - wetting down any handtools before and possibly during the pour will lead to an easier and cleaner pour - but don’t go over the top.

9. CURING

9.1 Curing is the last and one of the most important stages of concrete construction. The "curing" problem is caused by the concrete giving off heat and shedding water too quickly leading to cracking. If curing is not done properly, the concrete will not develop its full strength. Properly cured concrete is stronger, more resistant to chemical attack and erosion, and more watertight and frostproof.

9.2 The surface of the concrete is worst affected by poor curing, and it is this skin which gives concrete the ability to withstand wear and that protects both the reinforcement and the 'heart' of concrete. Therefore, if concrete is inadequately cured the effectiveness and the life-span of the concrete will be reduced.

9.3 It is, therefore, important for curing to take the proper time and this can be achieved in one of two ways:

- The first involves keeping the concrete moist by the use of ponding, spraying/sprinkling, damp sand or hessian.
- The second method prevents the loss of moisture from the concrete by covering it with polythene sheeting, spraying on a curing membrane or leaving the formwork in place.

9.4 The first methods are undoubtedly the more correct. However, they are expensive, labour intensive and time consuming. Moreover, if they are not carried out properly they may do more harm than good. The second group of methods, while not so efficient, are usually satisfactory for all except very special work and they can be carried out more easily.

9.5 Note that curing strengths given in specifications relate to the strength of the concrete after 28 days, recently "gone off" concrete (usually referred to as "green" concrete) may well be "crumbly" round the edges and care should be taken to protect it for at least several days after it has been poured.

10. EXTREMES OF TEMPERATURE

10.1 All of the above measures will ensure concrete reaches its full potential throughout much of the volunteers year (which is like a contractors year but longer and wetter!). However, modifications of concrete mix proportions and constituents may be required when concrete is to be placed in extremes of temperature. For cold weather the usual rule of thumb is only pour when it is over 4 degrees C on a rising thermometer. You also need to consider the fact that it gets colder a lot quicker towards the end of the day and protect the concrete from frost with additional cover whilst it goes off (you may wish to specify an accelerator in the mix to ensure the first stages of curing have occurred before it gets dark).

10.2 When placing concrete in summer months the usual limit is exposure to a temperature over 25 degrees C. Pay particular attention to the way that shadows move around during the day - the pour may be in the shade at 11am but will it be in the shade at 3pm? In both of these circumstances the producer will be able to offer advice regarding the suitability of the specified mix and relevant admixtures.

11. HANDMIXING

11.1 Many of the above considerations are valid for handmixing (or rather mixing using a concrete mixer), but in addition:

11.2 When planning a pour use a reasonable estimate of time per mix.

11.3 When using a mixer ensure that you add the materials in the right order as it takes ages to mix properly otherwise, the normal order is:

- 75% of the water
- 50% of the aggregate
- 100% of the cement
- 50% of the ballast
- final water to suit

but this can be varied to suit the materials (e.g. wet sand will require a lot less added water).

11.4 Generally you are doing something wrong if:

- you are getting splashed or,
- the back of the drum is getting caked with dry mix or,
- the mix is taking a long time (say more than 2 minutes from the addition of final water).

11.5 Ensure the water supply is adequate, clean and suitable. Ideally it should be mains water but if you must use canal water make sure it has no organic matter (weed, etc.) and is chemically suitable (pH neutral and saline free).

11.6 Pay careful attention to quality control when mixing by hand. Without doubt the best way to achieve consistent quality mixes is to use levelled buckets to measure out the materials rather than just shovels. Producing consistent mixes is a skill, though fortunately one that is fairly easily learnt.

11.7 When mixing by hand it is essential to keep up a steady rate of mixing so always ensure that you have the manpower to do the job and can supply the materials (including diesel and water) at a suitable rate - if not then make the job smaller. It is an unfortunate fact that nearly all possible contaminants will prevent concrete curing properly and so diesel spillages, etc. mean that materials must be discarded.

11.8 Ergonomics are very important when setting up a mixing site - Section 16 shows a well laid out site with some reasoning for the layout. One age old question that often holds up the start of a pour is whether it is better to set up the mixer by the materials and barrow the mixed concrete to the pour or set up the mixer by the pour and barrow the materials to it. It is an age old question because the right answer last time is rarely the right answer this time! In the author's experience it is usually more successful to keep the mixer near the materials and barrow the concrete but it really is site dependant.

11.9 Always clean the mixer immediately afterwards - a couple of shovels of clean, large ballast are more effective than the traditional half bricks. This is particularly important if your mixer is also being used to mix mortar for bricklayers. Equally important is to clean all splashes off the wheels and around the tipping area before they harden (unless it’s a security measure).

11.10 Your mixer may well have a starting cord (or at least a starting handle). The most common early morning game on site is "where's the ruddy starting cord?" - always keep the cord or handle in a known place. The

starting cord should be the proper article as a bit of old knotted string tied to a twig is a recipe for splinters, sprained wrists, etc.

11.11 You may wish to consider having a second mixer and/or vibrator on standby in case of machine failure.

11.12 If you are specifying a mixer then it is usually done in terms of the capacity of the mixer barrel, i.e. third of a cubic yard, etc. However, this is often corrupted into such descriptions as “half bag” mixers where this corresponds to the fact that the barrel can take half a bag of cement and enough aggregate to make up a standard C30 mix. They are also graded by their names; Baby Belle, Standard Belle, Liner Petter, etc. From experience when discussing the size of the mixer with a hire company it is most productive to try any or all of these techniques to narrow down exactly what they are delivering as many variations in nomenclature exist.

11.13 For the true masochists here is the guide to mixing by hand:

- Measure out the required aggregate onto a clean sheet of plywood,
- Form a crater in the top and add the measured amount of cement,
- Turn over until uniform in colour and texture,
- Form a crater and add the water slowly mixing as you go,
- Turn over (a lot!) until uniform in colour and texture and at the workability required.
- It’s just like making a cake.

12. MATERIALS AND STORAGE

12.1 Always store cement safely in the dry and ensure that stock is cycled i.e. that the bottom bag gets used. Note that cement will always go off, even when stored in the nominal dry conditions of a shed or store, only by totally surrounding the cement in airtight plastic can you extend its normal lifetime.

12.2 It is possible to get the aggregate and sand premixed before delivery and this can be a real boon in terms of storage and quality control - this is known as “all in concreting aggregate” but it is also called other things (see section 16). The ratio of large and small fines is important as it is this that determines the voids that can be filled (this is why it is best to use “all in concreting aggregate” as this ratio is already optimised).

12.3 Also beware the segregating effect of a long wagon journey - it may be necessary to remix the aggregate.

12.4 If you are doing a lot of pouring then it is well worth setting up a proper ballast store by laying a decent concrete base and setting up back and side walls (this will pay for itself in less wastage). Set it up so the delivery wagon can tip directly into it and also so the prevailing wind doesn’t blow ballast into the faces of the poor chaps shovelling it. An alternative is to use bagged supplies of sand and aggregate. This is generally more expensive but may well result in a higher level of quality control and less wastage and so be economic for small mixes on isolated parts of the site.

12.5 One final point, the whole world seems to think that volunteers spend their free time assembling neat, well ordered piles of sand and ballast just so their dog has somewhere to go to the toilet....beware.

13. HEALTH AND SAFETY ISSUES

13.1 No guidelines regarding the handling of concrete are complete without a mention of the safety issues involved. By educating everybody on site in the safe and correct use of concrete and what to do in the event of an accident, any problems can be minimised. It is essential that you have the COSHH hazard data sheet associated with the cement product and any other chemicals you are using - if you can't get these from your supplier then go direct to the manufacturer (Portland, Rugby etc.) and ask them.

13.2 Fresh concrete has a very powerful caustic effect on skin owing to the alkaline nature of cement. The abrasive effects of sand and aggregate in the concrete aggravate the condition and effects range from dry skin, irritant contact dermatitis, allergic contact dermatitis to severe burns. These burns can take several hours to occur and the author can confirm they can be very painful. Always ensure all those involved in the pour are aware of the dangers and have adequate protective clothing, such as overalls, gloves with close fitting cuffs, Wellington boots and safety helmets. Eye protection and eyewash are essential on any concrete pour. Any splashes should be removed immediately with lots of clean water. It is also essential to protect the public, not only from splashes during the pour but also from straying onto the pour whilst it goes off. (This will also result in less dogs called "Stumpy" and less paw prints in your carefully laid base.)

13.3 Your CDM plan may well require a Safe System of Work but even if it doesn't it is a good idea to have one anyway. In the case of concrete mixing and placement it really boils down to:

- how do I position everything so I can mix safely without getting everybody running into physical hazards (usually other volunteers and the public)?
- how can we place the concrete safely - i.e. sensible, tested barrow runs with different routes for empty and full barrows to avoid traffic jams, stop boards to tip against etc?
- are there any places or routes that are not safe for a concrete run and are they marked accordingly?
- have other requirements such as COSHH, First Aid, etc. been satisfied?
- has all of this been communicated to everyone involved?

13.4 It is also important that everyone involved in the pour is well briefed on lifting and handling techniques as considerable damage can be caused during the handling of materials - cement bag sizes have recently been halved to 25kg for this reason. Volunteers should be clearly instructed to look after their backs as they are often not used to such intensive effort - either the long, hard slog of a handmix or the frenetic intensity of a readymix pour.

13.5 Never start a mixer (or any other item of plant for that matter) unless you know how to stop it. You should store fuel safely away from the main work in clearly marked containers. Funnels are essential to avoid spills, if the mixer does have fuel spilled on it you must wait for the fuel to completely evaporate before re-starting the mixer. Other common hazards include exposed sharp reinforcing bars and lost limbs through reaching inside mixers whilst they are running - never do this.

13.6 Most incidents can however be avoided through education. It is worth noting that it is not simply altruistic motives that should guide your health and safety practices, one well known voluntary organisation ended up having to pay several thousands of pounds when a volunteer sustained cement burns on a work site.

14. FURTHER GUIDANCE

14.1 Further guidance on working with concrete can be found in the publications below:

The British Cement Association (01344 725704) produces a series of 11 booklets under the heading "Concrete On Site":

1. Readymixed concrete
2. Reinforcement
3. Formwork
4. Moving concrete
5. Placing & compacting
6. Curing
7. Construction joints
8. Making good & finishing
9. Sampling and testing fresh concrete
10. Making test cubes
11. Winter working.

The booklets can be purchased either as a set (£27.50 + p&p) or singly (£2.75 + p&p)

Readymixed Concrete Bureau (01344 725732) produce a series dealing with the handling of readymixed concrete called "The essential ingredient series":

1. Quality
2. Production and transport
3. Guidance on economic design, detailing and specification
4. Material
5. Concrete specification and mix design
6. Site practice
7. Testing
8. Making good
9. Today & tomorrow

RCB also produce:

"Concrete simplified" - a practical guide for site personnel.
"Site sampling and testing of concrete" - a site manager's guide

Blue Circle Cement (0800 236368) produce simple free leaflets.

Advice on Precast Concrete sections can be obtained from:
Culvert Box Association
60 Charles Street
Leicester, LE1 1FB Tel: 0116 253 6161

or

FC Precast Concrete
Alfreton Road
Derby, DE21 4BN Tel: 01332 364314

Advice on concrete paints and specialist finishes can be obtained from:
Keim Mineral Paints Ltd
Muckley Cross
Morville
Nr Bridgenorth
Shropshire
WV16 4RR Tel: 01746 714543

15. DEFINITIONS

15.1 **Ballast**: beware of local definitions; one site may refer to the sand/aggregate mix as ballast while another site refers to just the aggregate as ballast. Pay careful attention to the ratios of large and small fines as it is this mixture that ensures that all voids are filled (this is why it is best to use "all in concreting aggregate" as this is already optimised).

15.2 **Slump** is a not very subtle test to assess the workability of a mix. It involves filling a conical mould with the concrete to be tested and then inverting the mould. When the mould is removed the concrete naturally slumps under it's own weight. The distance from the top of the cone to the top of the concrete pile is the slump. The bigger the slump figure the more the concrete slumps under its own weight and hence the easier it is to move around. A standard mix (with 20mm aggregate) would have a slump of 50-75mm, this is easily shovelable (especially if vibrated).

15.3 **Test Cube** is a 150mm cubic mould filled with concrete taken at random from the pour. It is allowed to cure and can then taken away for testing at a lab. It is a way of proving to any third party that what was poured was within specification.

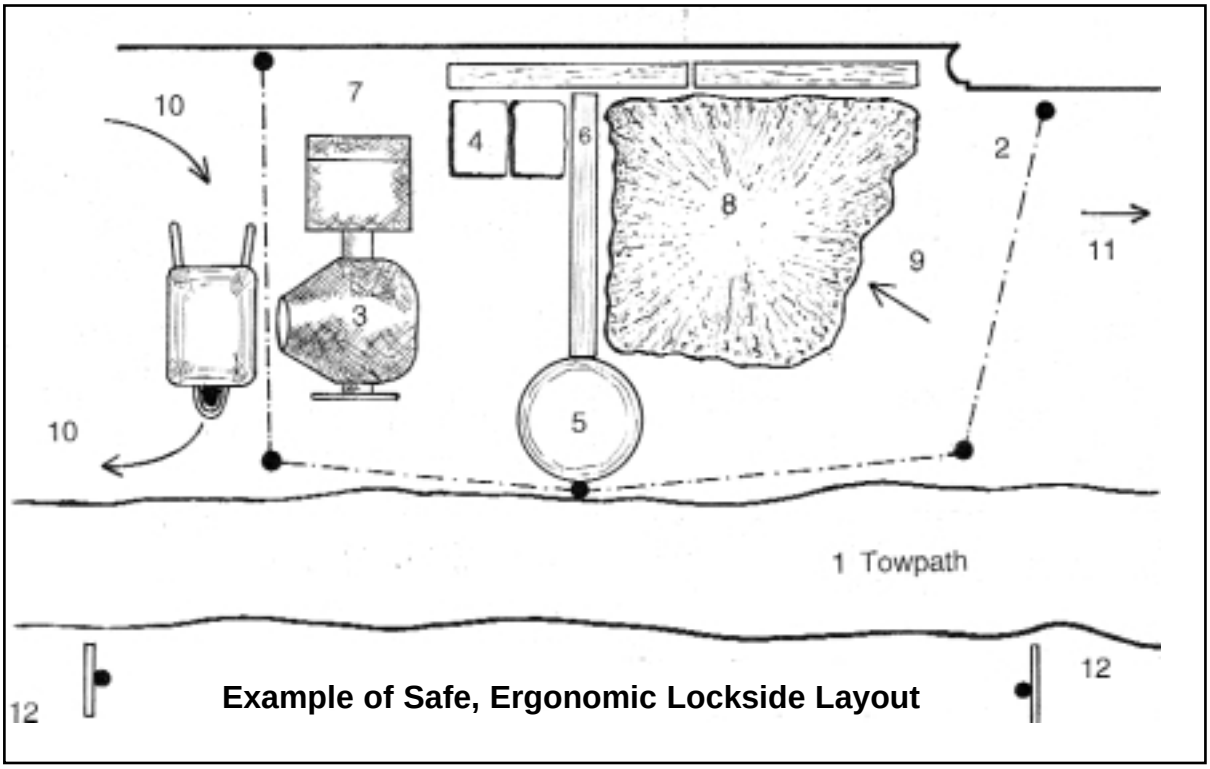
15.4 **Lean mix** is a concrete used for blinding off and it could be as low as C10 strength but is more usually C20.

15.5 **Grout** in this case refers to the suspension of cement and smaller fines in the water. It is important not to lose it as then only the larger fines will exist leading to honeycombing and a loss of density and strength.

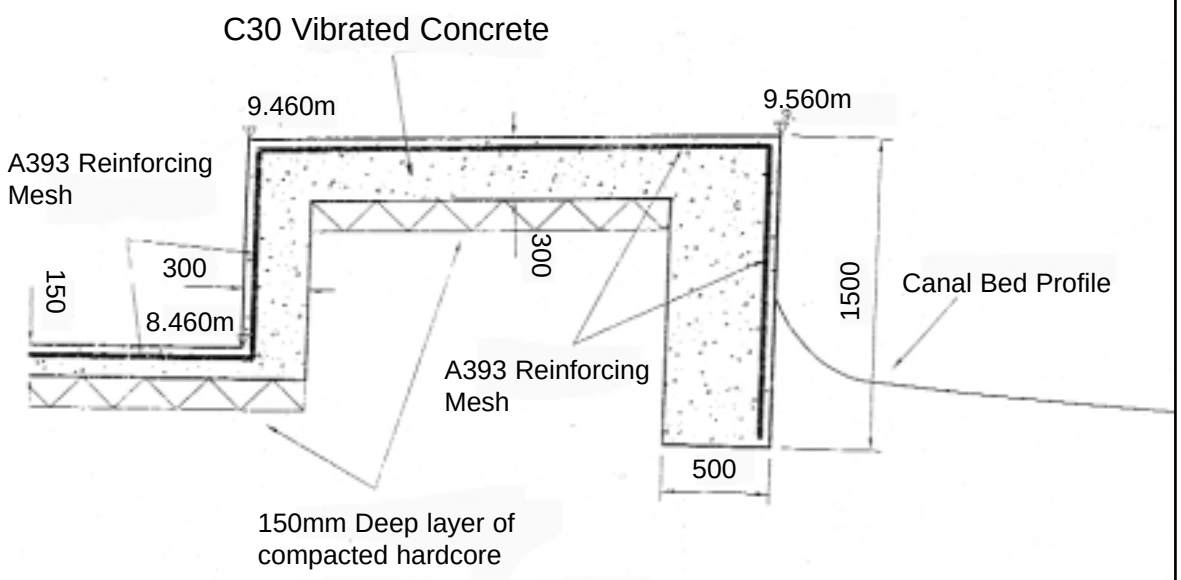
15.6 **Tamping** is the most common finishing technique. A straight, regular, smooth edge (usually a block of wood) is used to gently bounce off the concrete to vibrate the surface and produce a reasonably smooth and regular finish. The block should be raised no more than 50mm above the surface and brought down firmly so as to level out imperfections. Depending on the area of the pour the tamping block may be a small spirit level or a full length scaffold plank and may be worked solo or with a person on either end. Tamping is a skill and requires good coordination, particularly when two people are involved, as the block must move uniformly across the surface with the edge rising and falling onto the surface of the concrete evenly. It goes without saying that the block should be clean and free from splits, warps, etc. and should be cleaned off after use. Depending on the finish required the surface can then be trowelled, etc. if required or left as "tamped".

16. ATTACHED DRAWINGS

Key to Example of Safe Ergonomc Lockside Layout		
Key	**Item**	**Comment**
1	Towpath	Kept clear of materials, workers, debris etc.
2	Safety fence	Ready to be installed when work stops
3	Mixer	Positioned so that it can swing one way for loading and then over for unloading
4	Cement store	Safety stacked and cover over with plastic
5	Water butt	Alternative location would be near the mains water supply
6	Buffer beams	Railway sleepers (or similar) safely anchored to prevent spillage and waste of materials especially into lock chamber
7	Starting area	Enough room to safely start and stop the mixer
8	Ballast heap	Within easy shovelling of mixer and covered over when not in use to prevent contamination, ballast is tipped onto plywood sheets for ease of shovelling and minimum waste
9	Ballast heap	Safe direct tipping from dumper onto heap
10	Barrow run	There should be somewhere safe to hold barrows ready for use and a clear route that doesn't result in every body getting in each others way
11	Fuel store	Safely stored away from the main action
12	Warning signs	As appropriate to the work undertaken



Example of Safe, Ergonomic Lockside Layout



SECTION THROUGH WEIR CREST
1:20

Typical Concrete Structure Design

Dewatering

by
John Palmer
(WRG Plant Manager)

CONTENTS

1. DEWATERING

1.1 Introduction

This chapter intends to provide guidance for anyone struggling with too much water. The bulk of the chapter concerns pumps and pumping techniques as this is where experience shows the most information is needed. However, it is equally true to say that a successful dewatering is dependant not only on getting rid of the existing water but also stopping any more getting in. Because of this, preparation and clear thinking pay great dividends when attempting a dewatering.

1.2 General Considerations

There are three ways to get rid of water in the channel. One is to operate a sluice specifically built for the purpose, the second is to pull the plug out (assuming there is one in the section you wish to dewater) and the third is to pump it out. The golden rule for a successful dewatering is to have as much control as possible (this usually means doing it slowly!).

It is well worth appointing someone just to monitor levels and flows and ensure that the rest of the group can not only work in safety but also without worrying about whether their work is about to be washed away. Any tools required to operate the equipment (windlass, pump starting handle, etc.) should always be kept in a place known to all volunteers. It is also worth setting level marks to monitor levels as this may well prevent arguments later, particularly with third parties (it is recommended to set them on the offside to prevent tampering). However, when checking levels remember that given a strong enough flow a 'slope' on the canal is possible (up to 25mm over 500m).

If you are intending to use a sluice check first that it can take the flows you intend to send down it. Many sluices have not been used for a long time and not only is their mechanism often suspect but also the frames and even the culvert itself. Beware also of large items (branches, etc) sticking in the slide and preventing the paddle from going back down. Very embarrassing! So before operating in anger, clear the floating debris from an area of at least 5m from the sluice and keep a rake handy, you may even wish to fabricate a guard to stop the debris going down. Obviously be very wary if you go into the water to clear a blockage. However, at least a sluice can be dropped and the outfall stopped if it is all going wrong. This can not be said for the second technique - pulling the plug. Once that has started it is very difficult to stop so you had better be quite sure that you have got it right. The third technique of pumping is extensively dealt with later.

Timing is important as you need to consider the age old conflict as to dewatering in high summer (less water to get rid of), or to dewater in winter (lots of water to rewater with). You also need to consider the ecological impacts of dewatering at certain times of the season.

And finally remember that while you wish to remove all the water from your section others may find it necessary to maintain flow on either side of the section. Unless water supplies can be diverted from elsewhere it may be necessary to bypass the section with pumping. If the dewatering is over many days, or in particularly hot weather, it is important that the puddle clay lining doesn't dry out and crack otherwise potentially catastrophic leaks will occur. Therefore you should only dewater the minimum length necessary and it may even be prudent to partially rewater the section during the works to stop these cracks occurring.

1.3 Ecological Considerations

This is not just a case of removing any stranded fish (especially eels as they love to burrow through your dams and make them leak). You must also consider any effects of lowering the levels on vegetation; some marginal plants may well actually benefit from the level going up and down a little but others won't. Oxygen levels in whatever water is left will fall with potential problems. Timing throughout the year is a critical factor and expert guidance should be sought if the dewatering is long term (greater than a day or two). Of course if the work is necessary to prevent an imminent breach then ecological thoughts can be a little irrelevant.

One important consideration that must not be ignored is the potential impact of operating sluices or pumps into adjacent watercourses. Although the waters are often of a similar make up, you should still carry out an environmental impact study. This is obviously much more important where levels of pollution are high or where the ecology is very different. An example of this would be the Droitwich Junction Canal which is non saline in the section that runs through the highly saline marshlands by the M5 motorway. The Environmental Pollution Act is the relevant legislation.

1.4 Isolating the section to be worked on

There are five options: stop planks, sandbag dam, piling dam, specialist dams and earth bund. It should be said that dam design is a skill in itself and if you are unsure about the technique then it is best to get an expert to advise you. Because of this only a few golden rules are given here, for further advice on dam design please consult the IWAs Honorary Consultant Engineers who will be able to offer guidance (contact via IWA Head Office). You're probably going to get wet no matter which dam option you pick!

It is undoubtedly best to spend time getting your dam right from the start, even if only dewatering for a quick inspection. Not only is a properly sealed dam safer (even tiny leaks have a habit of getting very big, very quickly) but by getting the whole area dry so that you can see what you are doing you will not miss anything in your inspection. If the dewatering is to enable actual works then a well sealed dam is essential. This is not only on grounds of safety, but also because everyone will work a lot better if they are not having to argue every 30 minutes about whose turn it is to go up top and start that noisy pump again. Nobody likes wading around 4" of water and you'll lose far less pointing trowels if you can see where they have been dropped.

The legislation that refers to dams is the Construction (Health, Safety and Welfare) Regulations 1996. Regulations 12 and 13 state that "it is a requirement to ensure cofferdams and caissons are properly designed, constructed and maintained". The WRG implementation of this is as follows:

Dams must be inspected before work starts each day or whenever there has been a significant change in the level that the dam is holding back. Each inspection must be recorded in a register. Where this is not the official HSE form (F91(part1)B) it can be a page in the site log. Note that minor problems (seepage etc.) can be noted as "requiring monitoring" in the record. The question of who is competent to inspect is largely dependent on how the site is run. If the site is run properly then there will be a register of who is competent to inspect. If not then the decision will be made by the site leader based on the volunteers experience of other similar works, not just of installing the dams but of working with them. If the inspector was not involved in the installation of the dam then the installation specification should be made available to them and any significant points (e.g. "offside edge of dam braced against tree") should be highlighted. See PRH "Health & Safety Section 1" for further details.

1.4.1 **Stop planks**: This is, of course, the easy option and you should be installing stop plank grooves where you can as you restore your canal (assuming no heritage conflicts). For them to work it is essential that the grooves and particularly the base are in good condition and clear of debris. The planks themselves should be good quality and made for the installation concerned. (Note that some sets of planks are of differing lengths, this is to cope with the batter (i.e. vertical slope) of the wall that the groove is set in). The wood will swell in the water and so it is best if the planks are soaked in the canal for a day before installing.

Just because BW blokes manage to install stop planks without getting wet doesn't mean you will manage it, they spend their lives installing them and it is a skill. There is every chance you are going to have to don the waders/wetsuit/underpants/whatever and walk along the sill clearing it. If the base and the surrounding area is not clear then you are on a hiding to nothing.

Sealing the planks is an art in itself; firstly lower them into place (don't worry that they float, the weight of the next one on top will cause them to sink down) and then tap firmly along the top plank to seat them properly. The top plank should then be wedged into place with wooden wedges driven between the wetside of the wood and the groove. Dewatering should then commence. Don't be too surprised if the gaps between the planks have considerable leaks - these will 'take up' as the wood swells. The final leaks can be sorted by 'racking' the planks with wood ash. The ash is gently drizzled along the wet side of the planks; as it sinks it is sucked into the gaps between the planks and then expands to fill the void. The effect is truly magical. If you don't have any wood ash then try sand or soil but it won't be anything like as good. The modern equivalent of 'racking' is to cover the wetside of the planks with plastic sheeting but even this is not as effective.

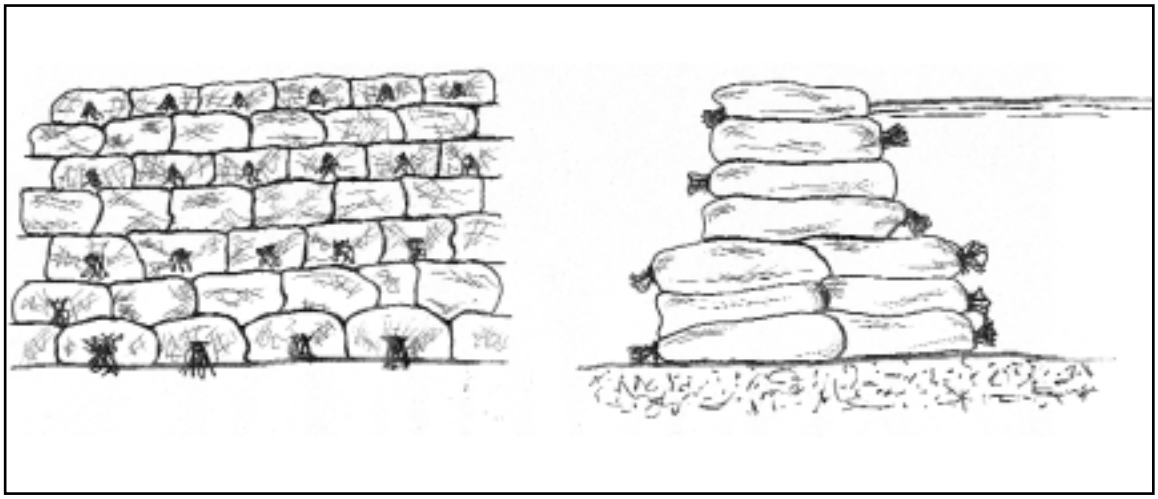
On wide waterways it is often the case that the planks will be additionally braced either by props from the gate recess or from upright beams placed into sockets behind the plank groove. The planks may also be very heavy and may require cranes to lift them.

When checking stop plank installations one particular thing to keep an eye on is 'boiling under' the base or 'spurters' around the groove itself. This indicates that the water has found a route through and is eroding it's way through. When a set of stop planks does blow out it is very impressive, unless you're in the hole!

Rewatering when stop planks are in place involves removing the wedges from the top plank and then gently prizing the top plank up from the next one by inserting a mattock or similar into the gap. Always do this from the bank, not by standing behind the planks. The planks are holding back a huge pressure and they will be held very tightly against the groove. Let the pressure equalise and the planks will free themselves and float upwards. Resist the temptation to just remove everything, the flow will be massive and will wash tons of silt over your stop plank base making it very difficult to use again. Always check you have removed all the stop planks you installed - it is not unknown for the bottom one to stay stuck, you'll have to go in and free it!

One final warning: stop planks are very heavy and many a volunteer has crushed a finger installing them. They do however float and a few volunteers have been shocked by the bottom plank finally working itself free and shooting up from the bottom - especially when they were standing astride it!

1.4.2 **Sandbag dams:** are 'easy' to install in that the job is relatively unskilled but they are hard work, in particular the work involved in supplying them is very tiring. The process of filling the bags, tying them off and then placing them is very hard going. To work properly they must be filled with a dense, homogeneous substance without solids. Strangely enough this usually means sand. As stated before design is a black art but for narrow dams (i.e. across a bridge hole) and for a low head (up to 450mm) it is acceptable to use a single bag laid perpendicular to the line of the dam. For any head greater then it is necessary to use double depth as shown below.



Installation is basically a case of carefully positioning them and building them up in layers. Once a layer is completed then walk along the layer to firmly knit it into the previous layer. The dam will tend to 'take up' a little especially if silt is drizzled down over the wetside where any seepages appear (the sandbag equivalent of 'racking'), however, if this doesn't work then it will require significant rebuilding. Installation is easy compared to removal which involves stopping down in the rapidly rising water to find every single one of them (and they all have to be removed to prevent a navigation hazard!) It is very cold work and hot drinks and suitable welfare and dry clothing should be available. Beware of swallowing the water and remind all workers of the dangers of Weils disease (see PRH "Health and Safety Section 2).

Most farmers/builders merchants can supply sandbags, they come in 'ordinary' and 'rotproof' grades. It is usually better to go for rotproof, though there is, of course, a cost premium. Unless kept very dry (unlikely don't you think?) ordinary sandbags will rot within a few months.

1.4.3 **Piling dams**: The same considerations concerning design and inspections apply to piling dams also. The good news is that many piling companies (who have an interest in selling you the piles of course) will provide free design advice. See PRH "Bank Protection" for further details on piling suppliers.

Piling dams are much more suited to real long term dewaterings, they consist of a line of interlocked piles with silt and dredgings piled behind them to stop the leaks through the clutches (the curvy bits that link each pile). It is essential that the piles are driven far enough into the bed to prevent not only the head pushing the piles over but also the weight of the water boiling under the piles and blowing them out. If there is significant head to hold back then it is common to use a double line of piles tied together. This has the advantage that the gap between them can be filled with dredgings, this has two benefits; it will seal the leaks through the piles and it will provide a walkway across the canal. However it is essential that you give the dredgings time to settle if you

intend to use it as a bridge and ensure the public can't get on it. Beware dredging too close to the dam as this will reduce the effective penetration of the piles (and then your dam will fall over).

1.4.4 **Specialist dams:** by this the author means such exotic items as canvas/scaffolding dams and inflatable dams. These are, quite simply, specialist and really in the hands of real companies who use the system full time. Certainly the author cannot think of any time volunteers have used these systems (no doubt someone will write in and correct him). They are very expensive. There is a rumour that British Waterways developed the inflatable dam system and then sold the patent as they didn't think it would amount to anything. It now costs them a fortune every time they use the technique. Only a rumour mind you. One technique being tried out just as this document was going to print was the use of sealed tanks filled with water to isolate a bridge hole on the Montgomery Canal. Contact the author to see how it turned out.

1.4.5 **Bunds:** these are, of course, the easy way to sort the problem out. It may seem strange to fill in the canal but with a large excavator and the right material it is probably only a couple of hours to install a bund and only an hour to remove it. This is much quicker than any other technique. The material has to be impermeable and have significant mass - this either means clay or a waterproof liner and soil, clay is much the preferred option as it is easier to repair. They don't need inspection, but obviously it is a sensible idea to keep an eye on it.

1.5 Rewatering

This is the reverse of dewatering and should still be done slowly and with considerable control. It is essential that a careful check is kept of banks, towpaths and over hedges to ensure that leaks are not occurring as the water level is brought back up. Ideally the level should be monitored for several days to ensure no leaks occur before the dams are actually removed. One option rather than just breaking out the dam is to pump or siphon over the dam, alternatively you may have been clever and designed your bund with a fill pipe through it.

1.6 Wellpointing, Wellpoint De-watering

The name given to surrounding the site with special 2" suction tubes set down to below the level of the workings. The spacing between points, and the distance out from the dig depend on local conditions, soil and water table (distance down you need to dig before your hole fills with water) among others.

All the small 2" pipes feed into a single 6" pipe and then to the pump. The 2" pipes, which are not uncommonly 12 feet long are drilled into the ground by forcing water at about 100 PSIG down them. A very good way of working since none of the pump bits are in the way at the bottom of the hole. Unfortunately not a lot of good to us!

2. PUMPS

2.1 Introduction

Put simply, a pump is a machine for moving something from one place to another. In our case the something is usually water(-ish) which has to be moved from where it is to somewhere permanently out of the way. Pumps can be divided into two classes, centrifugal and positive displacement, and are classified by the size of the internal hose diameter.

It is important to stress the need for good planning whenever setting up a pumping system. You should fully consider access requirements, inconvenience to the public, etc. You should also ensure that you have adequate fuel supplies to ensure that the pump is not stopped unnecessarily. A final important consideration is that of noise pollution, this is obviously a major concern with continuous through-the-night pumping but it is also worth considering if starting a pump early in the morning. There are a number of simple precautions that can be taken to prevent this being a problem (prosecutions for Noise pollution are becoming increasingly common). By careful placement of the pump and erection of screen, straw bales, etc the nuisance to the public can be minimised.

2.2 Pump Components

2.2.1 The Pump Itself

Any pump can be powered by an internal combustion engine (diesel, petrol or two stroke), hydraulics, compressed air, electricity, or even hand on some of the small reciprocating pumps. A discussion of the relative merits of each power source is available in the PRH "Plant".

Centrifugal or induced flow pumps have a high throughput and are meant for use with cleanish water. They rely on external help for priming (priming, in pump terms, concerns getting rid of the air in the system). Methods of priming vary, the smaller 2" and 3" pumps are often filled with water manually before starting and then rely on some clever internal design to remove the air from the suction side of the system, often by operating internal valves by an external lever. Others use a completely external priming system with either a vacuum pump to clear the air out or the exact opposite, an air compressor working into an ejector on the main pump body.

Positive Displacement pumps usually have a lower throughput than centrifugal types, but are capable of handling either clean water or slurry (a liquid with a high content of undissolved solids, e.g. mud). There are several types; gear, piston, peristaltic (irrelevant - you'll have to look it up), though all those I've seen in use on restoration projects are of the diaphragm type. Not a fast or impressive pump to watch, but try leaving one on overnight and see how much it shifts. Sometimes this type of pump is referred to as a Nodding Donkey, from the rocking bar which is a feature of many machines of this type. This type of pump is often left on snore - a very apt description of the sound of a pump which has reduced the level to a point where it is pulling air and water, and just dealing with seepage.

A pump on its own is merely the heart of a system and isn't much good without some other bits.

2.2.2 The Suction

The suction pipe, providing it is airtight, can be as long as you like as long as no part is more than about 20ft above the final level of the filter. The theoretical limit is about 27ft but this is asking a lot of the pump seals. It's a swings and roundabouts question as to whether a short high lift is easier than a longer (135ft was used not so long ago) lower length of lift. A longer pipe takes more time to prime, which means more water in the workings before it is removed. A longer suction may well allow the machine to be placed away from the working area and therefore appear quieter and less in the way. Suction pressure (or vacuum as it is negative), is often measured in inches of mercury ("Hg) and in reasonable site working 1" Hg can be taken as 1ft (300mm) lift of water. If the pump is below water level, e.g. the other side of stop planks, once primed the suction acts as a siphon

and the pump works at maximum efficiency. It is worth noting that the throughput of a pump falls dramatically as the suction height, not length, rises.

2.2.3 Filters

Filters are fitted to a pump suction to block up! It is easier to clear a blocked filter than to strip and clear a pump. Where several filters are available, give a thought to which is best for the job in hand. If doing a bulk pump down into a sediment based bed try suspending the filter with a rope and lowering it as the level falls. Generally avoid disturbing the area around a pump inlet until you have finished with it. The less you stir up the less chance of it blocking. One type of pump which does not have priming problems is the submersible. These do, however, still have trouble with blocked filters. And unless the filter is fairly fine you must be very careful that a jammed pump is switched off before clearing it, since a sudden restart could very well show one reason for painting plant blood red!

2.2.4 The Discharge

If everything else is working correctly this only has to direct the output out of the way. Air leaks, water leaks and general construction are of absolutely no consequence from the pump's point of view; indeed many small pumps are run without any outlet at all. However if it is feasible a suction quality length with its end under water can clear many pump blockages without intervention, especially when run on snore. If the suction and discharge are under water and the non-return valve jammed open the pump will often prime from the higher level and once primed will start pumping, taking the blockage with it. Discharge pressure is measured in pounds per square inch (or psi) and if needed for site work, with a free flowing end, it is reasonable to assume that for each pound of discharge pressure the pump is pushing the water to a height of 2 ft.

2.2.5 Couplings

Many types of couplings are in use, but I will only deal with those that I have seen around the movement.

BSP - British Standard Pipe. A very good thread but not really suitable for site use. The thread is very fine and clogs up, then wears very quickly and can be damaged when dropped.

URT - Urban Round Thread. A coarse thread more suitable for site work than BSP. Quite a lot of wrg hoses use this coupling.

FLANGED - Separate nuts and bolts, plus a gasket or seal; an awkward type of beast, very rarely seen.

INSTANTANEOUS - Most often seen on fire hoses and used on small bore discharges. Very easily connected and disconnected when not under pressure, and minor coupling leaks seal up under pressure. Will not work on suctions. Quite a lot of wrg blue 2” lay-flat hose uses these.

BAUER - A ball and socket coupling with an over-centre toggle clamp ring that should not need tools. It is designed to work up to 30 degrees out of line. Wherever possible these are the couplings fitted to WRG pumps. The lever often has a maker’s name stamped in it.

All the above couplings rely on a seal, usually rubber or plastic but sometimes exotic materials like leather are seen. Seals cost very little and can make all the difference to the speed of pumping, since every bit of air that leaks in is just more non-productive work for the pump to do, if indeed it ever actually gets primed.

If several different types of coupling are in use then various adaptors may need making up. You may be interested to know that the yellow plastic pipes in use by most gas utilities are just the right diameter for most couplings to push into and seal.

2.2.6 Hoses

These come in several grades and types. Suction quality hose is very heavy and usually made of ribbed, wire reinforced plastic or rubber and is relatively flexible when laying out. The black rigid plastic hose is claimed to be for discharge only, but is often employed on the suction without any problem. Lay-flat is discharge only and is completely different from the other two because, as its name suggests, it lays flat when not under pressure. Compared to rigid it is light and easy to move around but, except on straight runs or used under pressure, as in fire brigade use, only has to get a kink in it to stop all pumping. If straightening out this type of hose with the pump running please be very careful because the pressure inside the fold of a kink is painful! Occasionally, you may find a length of ex fire-brigade lay-flat which becomes wet on the outside, this is called percolating hose and is designed so that the damp outer face reduces damage over hot surfaces.

When setting up both the pump and the hose run think carefully about possible access needed during the job. It is bad practice to drive over hoses with dumpers, etc – a rigid suction will probably be destroyed and whilst a section of lay-flat may well survive it will be damaged by the weight of a dumper pushing it onto sharp stones beneath it. So think carefully; if you have to stop and disconnect halfway through the job and then restart and reprime will it affect the chances of success? Better to get the hoses to follow a route so they are out of the way in the first place.

WRG plant do have a source of 2” lay-flat, with instantaneous couplings. All lengths are damaged, but a box of jubilee clips works wonders, and for just the cost of transport, these could prove very reasonable. Contact the author for further details. Wherever hoses go over a solid edge care should be taken to ensure no damage can occur, both on principle and since a subsequent air leak could prove very difficult to find.

2.3 Maintenance

2.3.1 **Tools:** Both URT and BSP couplings are fitted with two or three small lugs for doing and undoing. Most of the time these are hammered together, eventually breaking off. There are proper spanners for this job and I am following up a possible supplier. A wire brush and spot of grease on all the threads can work wonders.

2.3.2 **Frost Precautions:** The name given to draining down a system to prevent ice forming, which at best will prevent you starting the pump or, more probably, will quite happily burst various expensive castings.

Most water-holding parts of the pump will have a valve or screwed plug/sealing washer, which is removed to drain down. Failure to replace tightly is another possible air leak during priming.

Frost precautions are invariably carried out at the end of the day, and involve cold machines, cold water and cold tools. They must, however, be carried out if there is the least chance of frost before you next expect anyone to use that pump again.

2.4 Failure to Prime

Several reasons are well known but try looking at the filter. If that is clear and the system has been working look for any joints that have recently cleared water level, either not tight or faulty seal, check the gland on the pump and - a problem I have only heard of once - the vacuum pump belt breaking. Even quite small twigs can stop a ball type valve from operating, if this happens then the pump will need to be stopped and stripped down and the debris removed. If on a diaphragm pump the water appears to be going in and out of the filter check the suction valve. If on a centrifugal pump a hissing rushing sound is heard from the discharge, the outlet valve is probably jammed open, which will probably need the pump stopping and a cover removing to clear. Having said that, lay-flat has been known to act as an additional NRV (non return valve). When the pump one gets jammed, you will notice it as it is sucked flat by the priming system. It would be quite reasonable to use a short length of lay-flat immediately after the pump then rigid to final discharge point. Another point to check is that all frost precaution drain points have been replaced or closed.

2.5 Odd Points (the hints and tips section)

If possible, give any pumps that have finished work a few minutes run in clean water. This clears them out and usually makes them easier to prime next time. This can be a viable idea if they get sluggish when pumping soup, just watch how long it is before clean water on the inlet comes out as clean water!

Two 3” pumps are not equal to one 6” pump! All other things being equal, the pumping capacity is proportional to the cross sectional area of the hose. A bit of schoolboy maths means that the capacity is increased by the square of the hose diameter. Thus you have:

Hose diameter	‘Hole’ available to pump through
2” pump	3 sq. ins.
3” pump	7 sq. ins.
4” pump	12 sq. ins.
6” pump	28 sq. ins.

So a move from a 3” to a 4” pump can produce a much improved flow (over 70% better).

Whilst a centrifugal pump will quite happily pump a certain amount of suspended solids these cause more wear than on a diaphragm pump.

If you dig a road sign out of the mine, observe that the support post makes quite a useful adapter/extension piece for 3” suction pipe.

Keep your eye on any oil pots, because running out of oil can introduce air leaks and increase wear quite considerably.

On those pumps with a removable plug for filling/priming, the plug is invariably on the outlet side and does not need to be more than finger tight. I have seen them hammered home when there is no pipe on the outlet, four interrupted inches away!

When rolling up lay-flat hose with instantaneous couplings, please note that the female end should be in the centre of the coil. It makes running out very quick and simple next time round.

When draining down pipework at the end of session please take care not to allow water to run onto a path where it could freeze and become a hazard to other users.

An increasing number of hire pumps are now appearing fitted with electric start. This makes life easier until the system fails: flat battery or jammed starter motor for instance. Don't lose the key!

Try and arrange for the correct starting handle to be supplied, it's easier than running around on Saturday afternoon when the hire place is shut. One of the most popular games with small hired-in pumps is "where's the jubilee clip gone?". This game can also be played with hose seals, special spanners, etc. Keep hold of all the bits and pieces and preferably keep a few spares in your tool kit as they will charge if you don't return them.

2.6 Pressures

PSI	-	Pounds per square inch
PSIG	-	Pounds per square inch gauge
PSIA	-	Pounds per square inch absolute

The only difference in the above is the measurement starting point, in that 'gauge' states that it takes normal atmospheric pressure as zero, whereas 'absolute' uses a total vacuum as zero. PSI on its own can be taken as PSIG.

2.7 Other Possible Solutions

2.7.1 **Siphons:** one wonderful device to take note of is the siphon. Once primed these work quietly and at no cost, 24 hours a day, and can shift quite large, but still controlled amounts of water.

2.7.2 **Ejectors:** or Venturi pumps. A system of using one pumped medium to cause a vacuum which moves another i.e. a high pressure pump pumps clean(-ish) water, inserted into the outlet is an adapter that has a lower pressure hose attached, the fast flow of fluid past the adapter causes a vacuum to be formed in the low pressure pipe. This suction is used to extract the "target" water/silt/etc. The high pressure pump is often ex-fire brigade. This is a system I don't know anything like enough about, but one where all the moving parts can be run in a much more controlled environment, and is one of the most effective methods of drying out a work site I have seen. It does however require a large source of clean water to run the high pressure side. Any more information would be appreciated.

2.7.3 **Bucket Chain:** don't laugh. This can be the quickest if the quantity is difficult i.e. shallow pools, full of short twigs, leaves, etc. A good way of mopping up pools possibly feeding on to a pump. Another technique is to consider using an excavator to bail out small pools. This is not a pretty solution and a large slurry pool often forms but can be successful.

APPENDIX 1 - GLOSSARY

Air balance chamber A tall tube, sealed from the air, on the outlet side of a diaphragm pump. Required on longer discharge runs to cut down pulsing and to smooth the water flow.

Cavitation The name given to a centrifugal pump thrashing around in an air/water mixture. It dramatically reduces the efficiency of a pump.

Clack valve A hinged flap type of one-way valve, usually opened by water flow and shut by an attached weight, or the weight of water above it. See NRV.

Diaphragm The flexible, usually fabric reinforced rubber, piece that moves in and out of the pumping chamber.

Eye The centre of the impeller.

Foot valve Not really part of the pump but a non-return valve in the filter. Normally in addition to the one in the pump and its inclusion can only help matters.

Impeller The part of a centrifugal pump which rotates at high speed and imparts motion to the liquid.

Loose lug General name for a coupling where part of it is free to rotate so that it can be tightened up.

NRV Non-return valve. A device to stop things flowing the wrong way. Sometimes a rubber-covered wooden ball, others are hinged flaps. See clack valve.

Packing Looking like nasty greasy rope, it is used to form an airtight seal between a static pump body and the rotating shaft.

SWA Steel wire armour hose. A type of hose where the shape is formed round a spiral wire frame work.

Volute The casing around the impeller, the pump body itself.

Vortex A hole in the water, from the surface to the filter, caused by the suction point being too near the surface. Causes air to enter the pump (cavitation!) and surface rubbish to be drawn onto the filter, which reduces pumping. A shovel or sheet of wood over the filter can prevent a vortex forming whilst not reducing water flow. Looks like the bath water going down a plug hole.

APPENDIX 2 - THE WRG PUMP FLEET

Okay so what pumps do we actually have on the wrg plant list and equally important what state are they in? This list represents a snapshot in time of the WRG pump fleet and is only included to show the fact that at anyone time only about 75% are working and most of those are on long term loan. Also note that it is not a case of thinking about just the pump; hoses, filters and the method of moving it around the country also need to be considered. The list was undoubtedly out-of-date when it was printed so please contact the WRG Plant Manager for further details. All are invariably in need of a clean down and repaint, otherwise:

P1 Lister diesel engined 3” Sykes Univac centrifugal pump. Undergoing a complete engine rebuild with Andy Greenwell, and should soon be available for use, it now has 100 plus feet of hose thanks to the eagle-eyed Dave Carnell who spotted some in his works scrap bin, which leaves only the filter and pump couplings to buy.

P3 Briggs and Stratton petrol engined 2” Bauer-couplings centrifugal pump. Usually seen with North West on lock clearances. 50’ suction and a quantity of lay flat, as needed, for discharge.

P4 Briggs and Stratton petrol engined Johnson Mk 18, 3” Bauer - couplings centrifugal pump. 100’ of rigid hose. Recently taken to Aston locks on the Mont. This beast has an external lever to select pump or prime. Unless on a good quantity pump out, this lever can be left on prime when the machine will pump 70% of its maximum capacity, but will deal with any air entering the system. Otherwise, any air entering when on pump will stop the pumping and cause the machine to thrash around with the water already in it, i.e. cavitate.

P5 Lister diesel engined, Johnson Mk 4, 3”, BSP-couplings, diaphragm pump. Both the pump and engine of the unit need looking at. It will then need new couplings plus hose and a filter.

P6 Lister diesel engined, Johnson Mk 4, 3”, Bauer-couplinged, diaphragm pump. 100’ of hose and a filter. Moved to Wilts and Berks Seven Locks project during April 89. The air balance chamber has recently been rebuilt, so that the valve seat is properly held down, and a new pin stops the support leg flapping around. Still burning oil but snores nicely.

P7 Villiers petrol engined, Simplite diaphragm pump. Has 2” suction and 3” discharge both push on and are then held with a screw clip, both now have a Bauer adapter permanently fitted. It has had a carb. rebuild (Alan Jervis no less!) and a new cover on the starter pulley so that it runs safely. At the first of the recent St. Helens weekend digs it was tested and proved capable of a 14’ lift and indeed was used in anger for the first time.

P8 Weda manufactured Bauer-couplinged 110 volt electrosubmersible pump. 2” Bauer couplings. Normally used by North West on it’s lock clearances. In full working order though we are looking at putting an automatic level controller on.

P9 3-phase 6” electric bore hole pump (a version of submersible, where the pump and motor are separated by several feet of shaft, so that the pump is submerged but the motor is in free air) apparently our most useless pump, but it came for just the cost of transport, having been spotted in an educational establishment’s waste bin. Before any of the limited number of sites with electricity can use it we will

need to obtain some cable and some piping, with luck and a following wind some recently donated control gear will provide auto or manual operation. The words “apparently useless” are used above since the first enquiry about this type of pump was two weeks after we obtained it, and from someone who knew nothing about it.

P10 Lister diesel engined Bauer-couplings, fast tow 4” Sykes Univac. A recent successful tender by North West. Needs checking over, certainly needs fitting with road lighting and the wheel bearings have been replaced. So that with some hoses a very useful extremely mobile machine should result. A spare wheel will also be needed at some time, 5-60 15 five study 4⅞” PCD (pitch circle diameter). Hint!

P11 Lister diesel engined 6” Sykes Univac, Bauer couplings machine. A recent donation from David Hutchings on the Upper Avon, where it was not in use enough to warrant keeping it on site. Has 100’ plus of hoses, needs a filter and routine check over then should make mincemeat of some of our long term pumping problems.

P12 Lister diesel engined 4” Sykes Univac, Bauer-couplings machine. A routine check and this complete machine should be another useful addition from David Hutchings.

P99 Coventry Climax petrol LPP (lightweight portable pump). Obtained via a man from the T&MCS. Believed working except that the plug caps have been removed and we do not have a suitable suction coupling.

Other Pumps

Also known to be in the restoration movement are pumps from the following stables:

Godwin DPC.6 dri-prime centrifugal

Honda 3” centrifugal. Search diaphragm pump

Search diaphragm pump

Selwood Spate 75C

Wickem diaphragm pump

APPENDIX 3 - THE WRG LITERATURE FLEET

The author has, or knows the whereabouts of, varying amounts of information on:

Coventry Climax Godiva pump (the LPP)

Godwin DPC.6

Honda WA20/WASO 3” pumps

Johnson Mk 4, 5, 9A, 148, 18

Selwood Simplite 50E Spate 75C

Sykes UVS

Weda SL164

Wickem 8” x 4” diaphragm pump

John Palmer
WRG Plant Manager
53 Southwood Road
Great Moor
Stockport
SK2 7DJ

In addition SLD pumps produce an excellent small booklet full of hints, tips, technical advice, for use when selecting pumps – it is highly recommended:

> Pumps, Hose, Jetting and Traffic Lights
> Hire Range and Technical Advice Book
> SLD Pumps Ltd

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