



DETAILED INFORMATION

Canal and River Structures

Introduction

All work near structures must be carried out with great care and forethought. It is the developer's responsibility to demonstrate that there will be no detrimental impact on existing structures.

Many existing structures were built before slope stability, foundation design etc. were understood. Materials and methods now taken for granted were not available. Compaction of embankment fill was not possible. It was not practice to prepare engineering drawings until the 1820s. Calculations were not undertaken until later in the 19th Century.

Old structures often have factors of safety close to unity. Factors of safety for embankments and cuttings reduce with time. Old structures are therefore particularly vulnerable to nearby works. Ill-considered excavations at the toe of an embankment, for instance, can have disastrous consequences.

Services and Hidden Hazards

Buried within the towpath and also present overhead are large number of services all of which have the potential to cause injury or disruption to the local community if damaged. Risks from striking underground high voltage electricity cables and gas services are significant. Some of these services maybe unfamiliar to vendors as they include strategic oil pipelines, fibre optic cable networks, and occasionally private services such as oxygen mains linking parts of adjacent factories together.

Increasingly the Trust has its own apparatus within the towpath providing power to locks and other structures and waterway monitoring / communication infrastructure.

Many of our structures are old and were never designed to accommodate the activities of the 21st century. Some modern plant and equipment can gain access to the canal in a way that was never envisaged when the system was constructed. It is worth remembering that the original canal system was operated by men and women with horses!

Some of the canalside buildings have fallen into disuse and entering them can present particular hazards ranging from weak floors through to abandoned materials which may be unstable or harmful.

Preserving the heritage of the canal system sometimes means that trip hazards and some unguarded falls may not be safeguarded in the way you may expect. Some of our structures particularly those below ground, such as culverts, can harbour poor air conditions sometimes with fatally low oxygen levels.

Hidden Hazards



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With 3000km of canals and waterways there can be specific hazards and conditions which maybe unique at a location. You are advised to seek more detailed information.

The Trust's waterways in general are not hazardous environments but there are some elements that need to be considered when working, or seeking access along, our property.

The canal system does not have an easy reference system for locating yourself when compared to most works where an address is often enough for suppliers and emergency services to locate your works. Site staff and suppliers need to be given accurate information to allow them to locate you from the adjacent road system. This may be a problem in both rural and urban areas.

Large areas of the canal network have poor reception for mobile phones and you should test coverage prior to the start of the works. Be aware that different networks have different coverage so there may not be universal coverage. Towpath conditions can vary throughout the year with some surfaces becoming wet and slippery particularly during the winter months.

Some lengths of canal can be very exposed and changing weather conditions can present new hazards.

Right of Support

The Trust enjoys a right of support under Common Law. It is important that support is not removed by excavation, dewatering undermining etc. In areas of mining subsidence canals can be of great depth due to bank raising - 10m is not unknown. Factors of safety are often not great and ill-considered actions can be disastrous.

A less obvious consequence of excavating near to canals is that of increasing hydraulic gradients. Not all canals are lined. Seepage rates are increased. Permanent leakage or piping failure can result.

Support to New Works

The Trust offers no support to new works. Loads should not be placed near to cuttings, over tunnels etc. without being independently supported. Should a Trust structure withdraw support from later development, the Trust would accept no liability. When building over tunnels, for example, not only should the new structure span independently the old but the effect of a collapse of the tunnel should be considered.

New Aqueducts, Locks etc

If it is necessary to build a structure which is of major significance to the Trust such as a new lock, a canal re-alignment, a mooring basin or the construction of a new aqueduct carrying the canal over a road, watercourse etc, the Trust reserves the right to carry out the design and supervise the construction on behalf of the developer (at the developer's cost).

Cofferdams



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When dewatering a section of canal, the usual options are to use stop planks, piling, clay stanks and fabric dams. Stop planks are rarely located at convenient points, resulting in extensive dewatering leading to safety and environmental concern. Piling is generally not allowed because of the damage to the lining caused by withdrawal. Clay dams can displace fluid silts over considerable distances, leading to access difficulty for removal by conventional plant and can cause water quality problems with dispersed silt on removal. Fabric dams are readily portable, can be supplied with flumes for water transfer, but are subject to undercutting, vandalism and boat impact. Inflatable dams may not be used. If large quantities of water could escape from the canal, it is usual to use secondary containment.

Fabric dams and stop planks must be protected from boat impact. All cofferdams should be checked on a regular basis by a competent person.

The developer is responsible for obtaining Environment Agency consent for the installation of any cofferdam if required.

Canal Linings

Although not all existing canals have an artificial watertight lining, works must be designed so that the canal is watertight. Works should be designed such that they do not penetrate the canal lining. Puddle clay is the most common lining material used in existing canals. It was rarely used with a thickness less than 500 mm however replacement may require a greater thickness.

Modern compaction plant needs clay of a somewhat lower moisture content, which is therefore less impermeable and a minimum thickness of 1000 mm is now normal. There is evidence that canals in sandy areas were lined in the 18th Century with manure to accelerate the rate at which the surface is sealed.

Modern lining materials include reinforced concrete, butyl and geotextile/bentonite membranes. bentonite must not be used in areas with high sulphate levels, or with lime stabilised materials. Membranes must be protected from boat propellers, boat-shafts and dredgers.

The old and new linings must be tied in using a suitable agreed detail.

Puddle clay must be placed in accordance with the requirements of *The Trust's Specification for Puddle Clay (available upon request from the Technical Manager)*. The Trust reserves the right to request copies of test certificates. Compaction of puddle clay into pile pans must receive special attention. Lime stabilised clays must not be used.

Interlocking sheet steel piles cannot be regarded as a lining unless backed in puddle clay, used in soils of low mass permeability, and / or clutch sealant such as 'Wadit' or 'Britseal' is to be used.

Water Level Control Structures and Cross Sections

The water level is normally controlled by waste weirs, by-washes and sluices and fluctuations in level can occur for a number of reasons, particularly during storms at the site



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and upstream, and during dewatering downstream. Care should be taken to define normal water level and maximum water level at the survey stage in consultation with the Technical Manager. Detailed surveys of weirs and sluices together with cross-sections of the waterway may be required and these shall be submitted before and after the works at the developer's expense. The contractor should particularly note when planning any work in relation to the waterway that the Trust cannot guarantee any particular water level or depth and not prevent any fluctuations to such water level depth or speed of flow in any waterway.

Requests to lower and maintain water levels slightly below those normal for that location are particularly difficult to achieve without alterations to structures and will usually cause navigation problems. They would also require constant monitoring and adjustment, all at the developer's expense.

All designs should consider flood defence and fish migration legislation. The designer is responsible for agreeing any design with the Environment Agency if required.

Water Control

At his own expense the developer will be required to maintain navigation feed flows and flows being transferred to abstractions past the site and to also deal with storm flows reaching the site at all times including outside normal working hours.

Bank Protection

The developer may encounter many forms of bank protection and any alteration or addition will have to be tied into the new works. The interface will need to be detailed to prevent an area of erosion forming.

Although the nature of the works often dictates a 'hard' bank protection system, the introduction of the Water Framework Directive means that any installation of hard bank must be to satisfy an engineering/safety need. The developer may have to agree their design with the Environment Agency and obtain consent.

It is often necessary to use a structural system of bank protection, such as interlocking sheet steel piling, for instance to act as a cofferdam to allow bridge footings to be built below water level or to allow the Trust's plant to pass along the towing path under a new bridge. Piling is also used in open cut service crossings to act as a water cut-off. Non-structural systems require the canal bank to slope into the channel and navigation must be considered in the design.

Although galvanised trench sheets are often used on smaller canals without pile capping, it is usual to install a reinforced concrete capping beam to structural piles. This beam should generally be made to accord visually with vernacular building materials for instance by laying brick or stone masonry to the upper face and fendering the vertical face.

Concrete and masonry walls are sometimes used but are difficult to construct without dewatering.

Where possible, 'soft' systems which allow a natural vegetation to develop at the water's edge, should be employed.. A range of techniques are available, including reed planted coir



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fibre rolls, brush wood rolls and hazel wattles. Sometimes timber washboards, gabions and stone filled mattresses, pitching and dry stone walls are appropriate. Guidance is contained in the Environment Agency R&D Publication No. 11 *Waterway Bank Protection: A Guide to Erosion Assessment and Management*.

The interface between the water's edge and the canal bank is one of the most valuable of the waterway habitats. Where installation of bank protection will involve disturbance to this area, surveys for the presence of water voles or white clawed crayfish are required at the early stages of the project. If found, the method of bank protection must be agreed with the Technical Manager to ensure their habitat is conserved, as required by law. In addition, all soil and plants (including reeds and aquatic vegetation) which are removed should be reinstated adjacent to the works.

Where original plants cannot be reinstated equivalent planting agreed with the Technical Manager must be carried out.

Future maintenance of bank protection systems must be addressed at the design stage.

Fendering

The permanent and temporary works must be fendered to protect the works from craft *and vice versa*. Modern narrow canal craft have overhanging bows and the steering skill of some

boatmen leaves something to be desired. Fendering materials include cast iron (used sometimes for heritage reasons), steel bullhead rail, recycled timber or timber obtained from legal and sustainable sources, polyethylene (which has low friction properties) and polyethylene faced rubber (which absorbs energy). The durability and maintenance of fendering must be considered and addressed at the design stage.

Bolt heads must not project. There should generally be no external angles; radii should be employed.

Any drilling of the waterway wall or coping stones must be agreed with the Technical Manager.

River Navigations

River navigations are affected by currents, floods and in some cases tides. There will be a deep navigation channel, not necessarily in the centre of the river. Elsewhere there may be insufficient depth to navigate. It is less easy to control vessels travelling in the same direction as the flow than those travelling against it. The former can move at considerable speed and need sufficient visibility and space to manoeuvre. Temporary and permanent works in the river can produce turbulence affecting navigation. The effects will vary in different river conditions.

Environment Agency consent as drainage authority will be needed as well as that of the Trust as navigation authority. The effects of all works on river navigations will need careful and specific consideration. Sailing vessels use some river navigations.

The Trust has powers and duties as Navigation Authority on those rivers listed in Statutory Instrument No 1195 "*The Inland Waterways of the Trust Board Order 1965*" as amended.



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The Trust is usually the freeholder for artificial sections but in general not so for natural river channels. Where the Trust is not the landowner, there will be no need for a contract with the developer however the principles of this process will apply, particularly with regard to the contents of the submission. The Trust has By-Law powers to control works affecting river navigations.

The By-Laws are published on the Trust website. The procedure outlined above must be followed except where it refers to the contract.