C8 Guidance notes

C8.1 General

Detailed guidance on steel bearing piles can be obtained from the Steel Construction Institute (see www.steel-sci.org) and the Steel Piling Group.

C8.2 Project specification

(f) Grades of steel

Steel bearing piles are normally manufactured to BS EN 10025 in grades S235, S275 and S355, but additional proprietary high-strength options are available from some manufacturers.

(j) Pile shoes

Toe protection shoes have been developed to prevent damage to the pile toe if it is penetrating debris, scree or other dense strata, the pile is being driven onto a sloping rock surface, or there is a need to increase the end bearing area of the pile. It is important to note that introduction of a shoe can lead to a loss of skin friction due to over-coring.

C8.3 Materials

Information on steel properties can be obtained from BS EN 1993-1-1 for bearing piles, BS EN 10210 or BS EN 10219 for tubular piles and BS EN 10248 for sheet piles and piles formed into box piles.

C8.3.2 Inspection and test certificates

In order to meet programme requirements it may not always be possible to inspect the production of piles. In some cases the piles may be manufactured before contract award and be made available from stock. In such cases records of mill tests should be made available to the contract administrator at least one week before work commences.

In the case of second life or reused materials, the appropriate justification required by BS EN 1993-5 shall be made available to the contract administrator one week before work commences.

C8.4.1 Ordering of piles

It is important to note that steel rolling mills do not always operate on fixed manufacturing cycles. The period from order to supply may vary from a few weeks to a few months according to section type, total tonnage required and overall market demand. If steel sections require processing after rolling such as painting or fabrication this will add to the lead-in time.

Good communication and planning by all parties to the contract is essential if the programme requirements are to be met. Varying lengths, sizes, steel thicknesses or grades after an order has been placed can be expensive and may cause delay. There is a significant risk where piles are ordered before completion of the preliminary test piles.

C8.4.3 Handling and storage of piles

Treated piles should normally be stored on timber supports or plastic/hemp packing to protect the coating. Rigid piles can generally be lifted from the ends but flexible piles often require two or more lifting points or the use of a spreader beam.

Recommendations for lifting sheet piles are given in annex A of BS EN 12063 and the same principles apply to lifting steel bearing piles.

C8.4.4 Installation

Steel tubes can be driven open or closed as low or high displacement piles. They are usually top-driven by impact hammers or vibro-driving methods, although pressing techniques have recently been developed for box piles. If piles are driven open, the soil on the inside may 'plug', that is, the soil within the tube moves down with the pile. If the piles are to be driven closed, an end-plate is usually welded to the end with suitable stiffening plates to prevent distortion of the end of the pile. If the tube is driven open and the soil inside is subsequently excavated, considerable care is required not to induce inflows of water or soil into the tube.

H-piles and hollow sections are essentially low displacement piles as the volume of material driven into the ground is low. However, if the section plugs with soil during driving to the extent that the plug moves down with the pile, the soil displacement will increase and the means by which resistance is generated will change from predominantly skin friction to end bearing. However, the steel section can be amended by the addition of plates and wings to enhance performance. Plating across the base of the section will increase the cross-sectional area of the pile which may be advantageous if the ground to be piled is suitable for generating end-bearing resistance rather than skin friction. Similarly, attaching short lengths of the same section at

appropriate positions along the pile shaft can be used to increase the surface area of the pile in strata which can provide high skin friction resistance.

In situations where piles need to be driven into a sloping rock surface it is possible to prevent the pile toe slipping down the slope during driving by welding a steel bar or pin to the toe of the pile which will dig into the rock surface and prevent movement. Having a smaller cross-sectional area than the pile, the pin concentrates the driving force onto a small area of rock causing it to penetrate the rock surface and hold the pile in place. The pin will generally be formed using high-strength steel to ensure that it will not buckle under the driving force.

It is possible to form a box pile by combining varying numbers of sheet-pile sections and, by using pile connectors to join the sections together, it is also possible to use pressing techniques to install these piles as each pile can be driven independent of its neighbours. This is advantageous in urban areas as the noise and vibration normally associated with the installation of welded-box piles can be eliminated and the piles can be extracted at the end of their useful life.

C8.4.11 Extraction

It is recommended that the contractor uses equipment which can provide an extraction force of at least twice the ultimate shaft friction of the pile.

C8.5 Coating piles for protection against corrosion

Considerable guidance is available on design corrosion rates for different situations within section 4 of BS EN 1993-5 and the 9th edition of the Arcelor Mittal Piling Handbook (2016). The corrosion rate applicable to steel piles installed into undisturbed natural soils tends to zero as both water and oxygen must be present for corrosion to take place. At depth there is little oxygen available so the process ceases.

C8.5.8 Thickness, number and colour of coats

Refer to Part 7 of BS EN ISO 12944.

C8.6.1 Site welding

Magnetisation of the heads of driven steel piles can occur and may result in magnetic arc blow during butt-welding of pile extension pieces, with detrimental effects on the quality of the weld. Degaussing of the pile head is necessary in these circumstances and can be achieved by the generation of a counteractive magnetic field during welding.

C8.6.2.1 Welded tubular piles

Where the use of uncertified welded piles is acceptable, appropriate testing (both destructive and non-destructive) should be carried out as required by the designer.

Timber piles

B9 Specification requirements

B9.1 General

All materials and work shall be in accordance with BS EN 1995-1-1, BS EN 12699 and Sections B1 and B9 of this specification.

B9.2 Project specification

The following matters are, where appropriate, described in the project specification:

(a) penetration or depth or toe level
(b) driving resistance or dynamic evaluation or set
(c) uplift/lateral displacement trials
(d) pre-boring, jetting or other means of easing piling driveability
(e) detailed requirements for driving records.
(f) grades and types of piles shoes
(g) species and grades of timber
(h) preservative treatment
(i) certification requirements
(j) details of pile encasement where required
(k) splicing
(l) lengths and dimensions
(m) other particular technical requirements.

B9.3 Materials

B9.3.1 Species/grade of timber

The species of timber shall be as stated in the project specification. Timber grading shall comply with the general requirements stated within BS EN 14081-1.

The grade of timber shall be as follows:

- softwoods – 'special structural' (SS) grade as defined in BS EN 1912, Table 1
- hardwoods – grade HS as defined in BS EN 1912, Table 2

or equivalent grades as defined by the project specification.

B9.3.2 Sapwood

Tree trunks for use as round piles shall have the bark removed but the sapwood left in place. They shall be treated with preservative as specified. Sawn or hewn softwood or hardwood that is to be treated with preservative need not have the sapwood removed. Hardwood that is to be used untreated shall be free of sapwood.

B9.3.3 Tolerance in timber dimensions

The tolerance on cross-sectional dimensions of sawn piles in relation to the dimensions specified shall be between +12 mm and −6 mm. The centroid of any cross-section of a sawn pile shall not deviate by more than 25 mm from the straight line connecting the centroids of the end faces of the pile.

Hewn piles shall be evenly tapered. The section dimensions shall not change more than 15 mm/m. The straightness of the pile shall not deviate from the straight line by more than 1% of the length.

B9.3.4 Preservatives

All preservation products shall comply with the project specification and be applied in accordance with the manufacturer's instructions.

B9.3.5 Certification of timber

The contractor shall provide confirmation that the timber has been sourced from well-managed forests or plantations in accordance with the laws governing forest management in the producer country, together with any other certification required in the project specification.

B9.3.6 Pile shoes

Pile shoes shall comply with BS EN 12699 and be manufactured from durable material capable of withstanding the stresses caused by the installation methods and ground conditions without damage. The material and dimensions of the pile shoes shall be as specified.

B9.4 Construction processes

B9.4.1 Inspection and stacking

The contractor shall notify the contract administrator 24 hours prior to the delivery of timber piles to the site or to the place of preservative treatment, and provide all labour and materials to enable the contract administrator to inspect each piece on all faces and to measure it at the time of unloading and immediately prior to driving.

Timber shall be marked and stacked in lengths on paving or drained hard ground. Each piece of timber shall be clear of the ground and have an air space around it. The baulks or piles shall be separated by suitable blocks or spacers placed vertically one above the other and positioned at centres which are close enough to prevent sagging. The timber shall be protected from the weather by means of roofing over with tarpaulins or other appropriate covering which allows free circulation of air.

B9.4.2 Treatment with preservative

Preservative treatment shall be carried out in accordance with the recommendations of BS EN 8417 or as specified. Cutting and boring of timber shall be done as far as possible before preservative treatment, but, where this is not possible, all surfaces subsequently cut or bored shall be heavily coated with preservative as specified in the relevant British Standard for preservative treatment or in accordance with the manufacturer's instructions as appropriate.

Certificates of treatment shall be obtained and presented to the contract administrator for all treated timber at least 24 hours prior to installation. The type and method of treatment shall be compatible with the type of timber and the use to which the timber so treated is to be put.

B9.4.3 Pile shoes

The shoes shall be attached to the pile by steel straps fixed, spiked, screwed or bolted to the timber. The shoes shall be coaxial with the pile and firmly bedded to it.

B9.4.4 Pile heads

The pile head shall be flat and at right angles to the axis of the pile.

Before driving, precautions to prevent brooming shall be taken. This may be done by trimming the head of the pile square to the axis and fitting it with a steel or iron ring. The ring shall be not less than 50 mm deep by 12 mm thick in cross-section and the join shall be welded for its full section. The external diameter of the ring shall be that of the least allowable transverse dimension of the head of the pile. The top of the ring shall be between 10 mm and 20 mm from the top of the pile. If the ring is displaced during driving it shall be refitted. If the ring is broken a new ring shall be fitted.

As an alternative to a ring, a metal helmet may be used, the top of the pile being trimmed to fit closely into the recess of the underside of the helmet. A hardwood dolly and, if necessary, a packing shall be used above the helmet.

If during driving the head of the pile becomes excessively broomed or otherwise damaged, the damaged part shall be cut off, the head re-trimmed and the ring or helmet refitted.

After driving, the heads of the piles should be cut off square to sound wood and treated with preservative before capping.

B9.4.5 Splicing

Piles shall be provided in one piece unless otherwise specified. A splice shall be capable of resisting safely any stresses which may develop during lifting, pitching or driving, and under loading. The position and details of the splice shall be as specified.

The splice shall be made as follows. The two timbers shall be of the same sectional dimensions and each cut at right angles to its axis to make contact over the whole of the cross-sectional when the two timbers are coaxial. A jointing compound shall be used at the contact surface. Round timbers shall be joined by a section of steel tube. Rectangular piles shall be joined by a prefabricated steel box section fitting the timbers closely or by steel splice plates. The connection shall be bolted, screwed or spiked to the timbers to keep the joined ends in close contact. The two parts shall not be more than 1 : 100 out of axial alignment.

Where it is necessary to extend a partly driven pile, the upper part must be securely supported during the making of the joint.

B9.4.6 Length of piles The length of pile supplied to be driven in any position and any additional lengths to be added during driving shall comply with the specification. During the construction of the works any changes to the supplied lengths shall be made known to the contract administrator.

B9.4.7 Spliced piles Spliced piles shall be observed continuously during driving to detect any departure from true alignment of the two parts. If any such departure occurs, driving shall be suspended and the contract administrator.

B9.4.8 Preparation of pile heads After driving, the piles shall be cut off square to sound timber to within 5 mm of the levels shown on the drawings and the cut surfaces shall be heavily coated with preservative as specified for the original treatment.

B9.4.9 Driving piles Pile installation and procedures shall be in accordance with BS EN 12699 and clause B1.14.

B9.5 Records

All records shall be in accordance with the requirements of clause B1.12 and the project specification.

C9 Guidance notes

C9.1 General

Timber piles for permanent structures should only be used below the lowest anticipated groundwater table or free water level during the lifetime of the structure unless adequate protection is provided.

Further guidance on the design and installation of timber piles, suitable species and preservative treatment is given in BRE Digest 479 and in BS EN 12699.

C9.2 Project specification

The first criterion to establish prior to installation of timber piles is what their end use is to be and what tolerances are required for the end product. For example, orientation in plan can be more critical if the pile is to be used to form a continuous structure such as groynes used for sea defences. Position and verticality may be more critical if the pile is to be used as a load bearing member of the structure. The overall appearance of the piles relative to each other and/or the remainder of the structure may be more important where piles are simply to be used as an architectural feature.

In groyne or wall applications, the position and orientation of the pile relative to the next pile is often more critical than the absolute position of the wall itself. As tides can also affect the pile position by releasing stresses in the ground, continuous monitoring is needed during installation to note any pile deviations so that they can be taken into account in the relative positions of subsequent piles. Final pile positions should therefore be checked and agreed immediately after pile installation. It may be necessary to place gates on the ground and/or attached to the piling rig to assist with accurate positioning of the piles. For other applications the amount or type of driving control should reflect the end requirement.

C9.3 Materials

Piling is a demanding application for timber, requiring material that is:

- strong and straight-grained
- adequately durable (or able to be made so with preservatives)
- available in large cross-section.

In addition, the general rise in concern for environmental issues requires timber certification on many projects.

C9.3.1 Species/grade of timber

Relatively few species comply with all three of the structural criteria. The most commonly used are:

- greenheart (a tropical hardwood)
- ekki (a tropical hardwood)
- oak (a temperate hardwood)
- Douglas fir (a softwood).

The structural grades given in the specification for tropical hardwoods and softwoods are appropriate for piling work. Enquiries should be made with suppliers in meeting the necessary grades.

C9.3.4 Preservatives

The natural durability of timber heartwood varies between species, while the sapwood of all species is effectively non-durable. Five durability classes are defined in BS EN 350-1, ranging from 1 (very durable) to 5 (not durable). The natural durability, and treatability with preservatives, of common species is given in BS EN 350-2.

BS EN 8417 gives recommendations for the durability class of timber in various locations. Timber in fresh water should be class 4 or better; timber in salt water should be class 5. Note also the relatively short life-expectancy of piles in salt water. This recommendation can be complied with in one of two ways:

- selecting a species with appropriate natural durability
- treating the timber with preservative to achieve the required durability.

Of the timbers suitable for piling, most hardwoods are extremely resistant to preservatives, and the softwoods are not durable. Thus the choice is generally between:

- hardwoods of durability class 4 or better, or
- softwoods treated with preservatives.

Consideration should be given to using the timber in the round (i.e. not sawn). The band of sapwood on the outside of round timber is normally more permeable than the heartwood and can be penetrated with a high loading of preservative. This can provide a better degree of protection than that to be expected from the limited preservative penetration often obtained in the heartwood of timber classed as resistant or extremely resistant.

The use of creosote and CCA (copper-chrome arsenic) treatment is heavily restricted so it is advisable to check current guidelines with the British Wood Preserving and Damp-proofing Association (see www.bwpda.co.uk) and the Environment Agency (EA).

Guidance on wood preservatives is given in the standards noted above, and further information and more details can be obtained from the British Wood Preserving and Damp-proofing Association and the Timber Research and Development Association (see www.trada.co.uk).

C9.3.5 Certification of timber

The two basic aims of certification are:

- legality
- sustainability.

The first is to provide assurance that the supplier or their agent was entitled to harvest the timber under the laws of the country of origin, and a clause to this effect should always be included in any specification.

Since timber is commonly used at some distance from the original area of growth, a number of internationally recognised forest certification schemes are now in operation, including the:

- Canadian Standards Association (CSA)
- Forest Stewardship Council (FSC)
- Malaysian Timber Certification Council (MTCC)
- Programme for the Endorsement of Forest Certification (PEFC)
- Sustainable Forest Initiative (SFI).

Suppliers may be able to provide timber which is certificated under one of the above schemes. At a less demanding level, many UK suppliers have adopted an environmental purchasing policy, can often confirm that all timber supplied has been obtained from legal sources and that it has been harvested in accordance with the laws and regulations governing forest management in the country from which it is sourced.

It is, however, important to issue a specification which does not contain requirements that are in practice unrealistic. It is strongly recommended that enquiries are made with suppliers so that the perceived importance of certification, or other assurances, is balanced against the species properties.

Further information on certification can be obtained from the Government's Central Point of Expertise for Timber Procurement (see www.proforest.net) and from the websites of the certification organisations noted above.

C9.3.6 Pile shoes

Spikes and points tend to induce splitting and capping rings tend to come off during driving. A flat plate is preferred to provide protection to the pile end and to prevent splitting.

C9.4 Construction processes

If spikes or points are fitted to the pile and are not square, it may not be possible to drive the pile vertically as it will naturally tend to deviate off line. Capping rings should be fitted tightly and perpendicular to the long side of the pile to reduce any tendency to come off during driving, and a flat plate may be preferred to provide protection to the pile end and to prevent splitting.

Piles should be driven with a packing at the head and the ends should be chamfered if no fittings are to be used.

Diaphragm walls and barrettes

B10 Specification requirements

B10.1 General

All materials and work shall be in accordance with sections B1, B10, B20 and B21 of this specification and BS EN 1538.

In this section the term 'panel' shall refer to both walls and barrettes.

B10.2 Project specification

The following matters are, where appropriate, described in the project specification:

(a) performance criteria for movement under vertical loads
(b) support fluid
(c) panel dimensions (minimum or maximum thickness and/or panel length)
(d) additional overbreak tolerance
(e) preliminary test barrettes
(f) water stop requirements (diaphragm walls only)
(g) instrumentation
(h) base or shaft grouting (barrette only)
(i) temporary backfill material
(j) integrity testing
(k) permissible materials for permanent stop-ends
(l) period for approval of contractor's drawings
(m) trial panels
(n) other particular technical requirements.

B10.3 Materials

B10.3.1 Support fluid

Bentonite and alternative support fluid materials, additives, mixing, testing and use of clean water, shall be in accordance with section B20.

B10.3.2 Permanent stop-ends in diaphragm wall panels

Materials shall be in accordance with the project specification.

B10.3.3 Grout

All material requirements with regards to shaft or base grouting shall be in accordance with section B3.5.11.

B10.3.4 Alternatives to steel reinforcement

The contractor shall submit with the tender information the material properties of the proposed alternatives.

B10.4 Construction tolerances

B10.4.1 Guide-wall

The finished internal face of the guide-wall closest to any subsequent main excavation shall be vertical to within a tolerance of 1 in 200 and the top edge of the wall shall represent the reference line. There shall be no ridges or abrupt changes on the face and its variation from its specified position shall not exceed ± 15 mm in 3 m.

Unless otherwise stated in the project specification, the clear distance between the inside faces of the guide wall shall be the maximum grab or tool size plus 20 mm, with a tolerances of $+10/-0$ mm.

B10.4.2 Diaphragm wall and barrettes

Tolerances shall be in accordance with clause B1.8, unless otherwise stated in the project specification. In the case of barrettes, the above specified maximum deviation shall apply in any direction.

An additional tolerance of 100 mm shall be allowed for concrete protrusions formed by overbreak or resulting from cavities in the ground. Where soft, loose or organic soil layers are anticipated, or obstructions are to be removed during panel excavation, an additional overbreak tolerance shall be stated in the project specification. Responsibility for the removal of overbreak shall be stated in the contract.

B10.4.3 Recesses

Where recesses are to be formed by inserts in the wall, the vertical tolerance shall be that of clause B10.4.4 plus an additional tolerance of +10/−10 mm beyond the toe of the highest cage section, and the horizontal tolerance shall be that of clause B10.4.4 plus the horizontal tolerance from clause B10.4.2.

B10.4.4 Reinforcement

Reinforcement shall be maintained in its correct position during concreting of the panel within a vertical tolerance of +70/−50 mm (i.e. a maximum of 70 mm high) on the level of the reinforcement projecting above the final cut-off level. The longitudinal tolerance of the cage at final cut-off level measured along the excavation shall be ±75 mm within the panel.

B10.4.5 Concrete casting level

If the cut-off level for the panel is less than 1 m below the top level of the guide-walls, uncontaminated concrete shall be brought to the top of the guide-walls. If the cut-off level is greater than 1 m below the top level of the guide-walls, concrete shall be brought to 1 m above the cut-off level specified, with a tolerance of ±150 mm. An additional tolerance of +150 mm over the above tolerances shall be permitted for each 1.0 m of depth by which the cut-off level is below the top of the guide-wall, up to a maximum of 2.0 m.

B10.4.6 Dimensions of panels

The thickness of a panel shall be not less than the specified thickness.

The lengths of all panels shall be within the limits on length specified in the project specification. The contractor shall be responsible for selecting panel dimensions which ensure stability. If, in the contractor's opinion, the specified panel dimensions are not adequate to ensure stability, the contractor shall inform the contract administrator at the time of tender.

Stop-ends shall be installed to within a positional tolerance of ±25 mm at guide-wall level.

B10.4.7 Water retention

The contractor shall carry out the repair of any joint, defect or panel where, on exposure of the diaphragm wall, the wall is not deemed 'watertight' as specified in clause B1.9.

B10.5 Construction processes

B10.5.1 Drawings

The contractor shall produce construction drawings including a panel layout drawing and reinforcement fabrication drawings for each panel. These drawings shall be submitted to the contract administrator in accordance with the approval period stated in the project specification.

B10.5.2 Guide-walls

The design and construction of the guide-walls shall be the responsibility of the contractor and shall take into account the actual site and ground conditions, all temporary loadings whether from reinforcement cages, stop-ends or equipment and the required level of support fluid to ensure stability and to avoid under cutting of the guide-walls. Guide-walls shall be constructed in reinforced concrete or other suitable materials. Unless agreed otherwise by the contract administrator, the minimum depth of guide-walls shall be 1.0 m and the minimum shoulder width shall be 0.3 m for reinforced concrete guide-walls. Reinforcement continuity shall be provided between adjacent sections of guide-walls.

B10.5.3 Stability of the excavation

A suitable guide-wall shall be used in conjunction with the method to ensure stability of the strata near ground level until concrete and any backfill material has been placed.

During construction the level of support fluid in the excavation shall be maintained within the guide-wall or stable ground so that panel stability is ensured.

In the event of a loss of support fluid from an excavation, the contractor shall notify the contract administrator of their intended action before proceeding.

B10.5.4 Cleanliness of the base

Prior to placing reinforcement or concrete, the contractor shall clean the base of the excavation of loose, disturbed and remoulded materials in accordance with the method statement.

B10.5.5 Condition of support fluid prior to concreting

The contractor shall ensure that contaminated support fluid, which could impair the free flow of concrete from the tremie pipe, has not accumulated in the bottom of the panel. The contractor shall wholly or partly remove and replace contaminated support fluid while maintaining stability, until it complies with the stated limits for the support fluid. Refer to Tables C20.1 and C20.2.

B10.5.6 Stop-ends in diaphragm wall panels

The contractor shall state in their tender the type of stop-end proposed and whether they will be removed or permanently cast into the panel.

Stop-ends shall be of the length, thickness and quality of material adequate for the purpose of preventing water and soil from entering the panel excavations. The external surface shall be clean and smooth.

Stop-ends shall be rigid and adequately restrained to prevent horizontal movement during concreting.

If excavation is by the use of a reverse circulation mill and stop-ends are not proposed, the contractor shall provide sufficient overcutting of the adjacent panel to ensure that a continuous competent joint is produced over the full depth of the panel.

B10.5.7 Placing concrete

Before commencement of concreting of a panel, the contractor shall ensure that the ready-mix supplier will have available sufficient quantity of concrete to construct the panel in one continuous operation.

The concrete shall be placed without such interruption as would allow the previously placed batch to have achieved a stiffness that prevents proper amalgamation of the two concrete batches.

No spoil, liquid or other foreign matter shall be allowed to contaminate the concrete.

The slump range or target flow for concrete to be placed through support fluid shall be stated in the method statement.

The concrete shall be placed through a full-length rigid pipe (tremie) in one continuous operation. Where two or more tremie pipes are used in the same panel simultaneously, care shall be taken to ensure that the difference in concrete level is kept to a minimum. The levels shall be recorded next to the tremie pipes or at the ends and centre of the panel. On commencement of the pour concrete shall be discharged at each tremie simultaneously until complete coverage of the base of the panel has been achieved to a concrete depth of at least 3 m.

The internal diameter of the pipe of the tremie shall be of sufficient size to ensure the easy flow of concrete. The internal face of the pipe of the tremie shall be free from projections.

The tremie pipe shall be so designed that external projections are minimised, allowing the tremie to pass within reinforcing cages without causing damage.

The tremie pipe shall at all times penetrate the concrete which has previously been placed with a maximum embedment which permits the free flow of concrete out of the base of the tremie hopper and a minimum embedment of 3 m. It shall not be withdrawn from the concrete until completion of concreting. At all times a sufficient quantity of concrete shall be maintained within the pipe to ensure the pressure from it exceeds that from the support fluid and workable concrete above the tremie base.

The hopper and pipe of the tremie shall be clean and watertight throughout. Initially, the tremie pipe shall be installed to the base of the panel. Thereafter it may be raised by no more than 200 mm in order to minimise the risk of concrete blockages. Prior to initial discharge, a sliding plug or barrier shall be placed in the pipe to prevent direct contact between the first charge of concrete in the tremie and the support fluid. If vermiculite is used for this purpose, then the volume used shall be sufficient to equate to a barrier whose length is at least twice the tremie pipe diameter.

B10.5.8 Temporary backfilling above panel casting level

After each panel has been cast, any empty excavation remaining shall be protected and shall be carefully backfilled as soon as possible with inert material in accordance with the project specification. Prior to backfilling, panels shall be clearly marked and fenced off so as not to cause a safety hazard.