

Sacred Heart Secondary School, Clonakilty

Enabling Works II Specification

220056-DBFL-XX-XX-SP-S-0007

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1 SCHEDULE OF DBFL SPECIFICATIONS REQUIRED FOR CONTRACT

SCHEDULE OF DBFL SPECIFICATIONS REQUIRED FOR CONTRACT	
PROJECT TITLE SCARED HEART SECONDARY SCHOOL, CLONAKILTY, CO. CORK.	PROJ. No. 220056
SPECIFICATION TITLE	DATE June 2026
SUB-STRUCTURE EXCAVATION AND BACKFILLING	✓
MATERIALS FOR ROADS AND SEWERS	✓
ROADS AND FOOTPATHS	✓
PIPELAYING AND JOINTING	✓
MANHOLES, etc CHAMBERS AND COVERS	✓
PILING WORKS	
GROUND IMPROVEMENT USING STONE PILES	
UNDERPINNING WORKS	
CONCRETE WORK	✓
PRECAST CONCRETE ELEMENTS	
BLOCKWORK AND BRICKWORK	✓
FACING BRICKWORK	
STRUCTURAL TIMBERWORK	✓
STRUCTURAL STEELWORK	✓
PALISADE	
METAL DECKING	
SETTING OUT	✓

2 SUB-STRUCTURE & EXTERNAL EXCAVATION AND BACKFILLING

SPECIFICATION FOR SUB-STRUCTURE & EXTERNAL EXCAVATION AND BACKFILLING

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PREAMBLE:

This specification contains six pages.

Where the contract to which this specification is being applied is of any form other than the RIAI Standard Form of Contract, then all references herein to 'the Employer's Representative ' shall be deemed to be replaced by an equivalent reference to 'DBFL Consulting Engineers'.

References herein to Irish Standards, IS European Standards and British Standards do not give year of issue or dates of amendment. The latest relevant published version including any relevant amendments at date of invitation to tender shall apply.

Where a Standard has been superseded the latest edition of the superseding publication shall apply.

References herein to other specifications shall be to DBFL specifications unless noted otherwise.

Where the preambles to the Bills of Quantities and the Standards referred to herein are at variance, the more onerous requirement shall take precedence.

Requirements of the Building Regulations shall take precedence over any requirement referred to herein.

01 DEFINITION, CLASSIFICATION AND GENERAL USE OF EARTHWORKS/MATERIALS:

1. The following definitions of earthworks materials shall apply to this and other Clauses of this Specification in which reference is made to the defined materials:
 - (i) "Top Soil" shall mean the top layer of soil that can support vegetation.
 - (ii) "Suitable Material" shall comprise all that which is acceptable in accordance with the Contract for use in the Works.
 - (iii) "Unsuitable Material" shall mean other than suitable material and shall include:
 - (a) material from swamps, marshes or bogs;
 - (b) material susceptible to spontaneous combustion;
 - (c) material in a frozen condition or material which after being frozen is not approved for use;
 - (d) clay of liquid limit exceeding 80 and/or plasticity index exceeding 55;
 - (e) materials having a moisture content greater than $\pm 2\%$ from optimum moisture content from B.S. Compaction tests or otherwise approved by the Employer's Representative on Site.
 - (iv) "Solid Rock" shall include rock found in ledges or masses in its original position which would normally be removed by blasting, pneumatic tools, or by wedges and sledge hammer, if removed by hand; also solid boulders or detached pieces of rock exceeding 0.10m cubed in size in trench and 0.2m cubed in size in general excavation.
2. Materials are grouped as follows:
 - (i) "Cohesive Soil" includes clays and marls with up to 20 per cent of gravel and having a moisture content not less than the value of the plastic limit (determined in accordance with B.S. 1377 test No.3) minus 4; also chalk having a saturation moisture content of 20 per cent or greater.
 - (ii) "Well-graded granular and dry cohesive soil" includes clays and marls containing more than 20 per cent of gravel and/or having a moisture content less than the value of the plastic limit (determined in accordance with B.S. 1377 test No.3 minus 4, well-graded sands and gravels with a uniformity coefficient exceeding 10, chalk having a saturation moisture content within the range 15-20 per cent.
 - (iii) "Uniformly-graded material" includes sands and gravels with a uniformity coefficient of 10 or less, and all silts. Any soil containing 80 per cent or more of material in the particle size range 0.06 - 0.002 millimetre will be regarded as silt for this purpose.
3. All peat shall be removed from the areas of the Works and carted off Site to a Landfill licensed to accept peat.
4. Unless otherwise described in the Contract, all topsoil shall be removed from the areas of the Works and if surplus to requirements, carted off Site to a landfill licensed to accept topsoil.

02 STRIPPING

1. The areas to be excavated shall be stripped of top soil.

03 DIMENSIONS AND EXTENT OF EXCAVATION

1. Excavations shall be taken out to the least dimensions required to accommodate the several parts of the Works and shall provide any working space necessary for their execution as required by the Contract.
2. The Employer's Representative shall have authority to limit the area of formation exposed at any time.

04 UNSUITABLE MATERIAL

1. Unsuitable material shall be removed from foundations of the works and elsewhere on the Site as may be directed.

05 DISPOSAL OF MATERIAL

1. All excavated material not required for refilling and all unsuitable materials shall be disposed of as previously described.

06 SUPPORT

1. Excavations shall be timbered, sheeted and piled or otherwise supported to the extent necessary to support the surrounding ground and to ensure the safety of the works and adjacent structure.
2. Unless otherwise required by the Contract no timber or other supports shall be left in excavations without consent.

07 EXCAVATIONS SHALL BE KEPT FREE FROM WATER

1. The Contractor shall provide and maintain and operate the pumping plant, and shall construct such grids, drains, sumps and catchwaters as may be necessary to remove water from the excavations or to prevent its entrance thereto. Water in the excavations shall be dealt with in such manner as will prevent the surfaces on or against which foundations or other work will be constructed from any deterioration of their natural condition, or from such condition as improved by work executed under the Contract.

08 FOUNDATION LEVELS AND PREPARATION OF FOUNDATIONS

1. Foundation levels shall be at the levels shown in the Contract or at such other levels as may be directed. In the latter case it may be directed that any extra depth of foundation shall be brought up to the levels shown in the Contract with mass concrete as directed by the Employer's Representative or with suitable material compacted as required by the Contract.
2. The Contractor shall make good with concrete:
 - (i) any excavation greater than the nett volume required for the works as defined in Clause 03.
 - (ii) any additional excavation at or below the bottom of foundations to remove material which has become unsuitable.

3. When approaching foundation levels in excavations in material other than rock, the final trimming to these levels, whether for actual foundation or for any blinding concrete required by the Contract, shall not take place until placing of the blinding concrete or of concrete in the foundation is about to commence.
4. In the event of the Contractor requiring to trim the foundations in advance of readiness to place concrete, the trimmed foundations shall be protected against the ingress of moisture or the evaporation of soil moisture.
5. Where necessary the Contractor shall include in his rates for trimming of foundations by hand in particular at critical locations such as steps in foundations.
6. In the case where blinding concrete is required by the Contract no trimming of side faces of excavations shall be carried out for 24 hours after the placing thereof.
7. Where foundations are in rock, as the excavations approach finished level, the Contractor may be directed to continue excavating without the use of explosives or with limited use thereof by shallow holes and light charges. The final trimming of the foundations shall be executed without explosives by approved hand tools.
8. Immediately before placing concrete against rock surfaces, all loose and soft material shall be removed from the rock surface by the use of stiff brooms, hammers, picks, and air/water jets. Before the placing of concrete, all water shall be removed from the depressions and the Contractor shall take all measures necessary to keep dry and properly drained all rock faces against which concrete is to be deposited.

09 REFILLING OF EXCAVATION AND REMOVAL OF SUPPORTS

1. All backfill material to substructure excavation and below floor slabs to be granular fill in accordance with SR 21 : Annex E 2014 as a minimum standard. Specification and test certificates of proposed material to be forwarded to Consulting Engineer for their review.
2. Timber sheeting and other excavation supports shall be carefully removed as the filling proceeds except where they are required by the Contract or directed to be left in position.
3. During the refilling, excavations shall be kept free from water as required by Clause 07 of this specification.

10 FORMING OF EMBANKMENT OR OTHER AREAS OF FILL

1. The areas on which embankments or other areas of fill are to be constructed shall be stripped of top soil unless otherwise directed.
2. Embankments and other areas of fill shall be formed of suitable material. Additionally, if approved, material wetter than the appropriate limit provided by the Contract under inclusion of Clause 01, iii E of this specification may be incorporated.
3. All earthworks material placed in or below embankments, below foundation levels or elsewhere in the works other than on roofs of underpasses shall be deposited and compacted as soon as practicable after excavation in layers of thickness appropriate to the compaction plant used as permitted in Table 1, of Clause 11 of this specification or as a permitted departure therefrom. Embankments shall be built up evenly over the full width and shall be maintained at all times with a sufficient camber and surface sufficiently even to enable surface water to drain readily for them. During the construction of embankments, the Contractor shall

- control and direct constructional traffic uniformly over their full width. Damage to compacted layers by constructional traffic shall be made good by the Contractor.
4. Filling on roofs of underpasses shall be placed in an approved progression by such plant as will avoid risk of damage to the structure through unbalanced or excessive loading. Compaction of such filling shall be effected as required by the Contract or as directed.
 5. Compaction of embankment and other areas of fill shall be undertaken to the requirements of Clause 11 of this specification.
 6. If the material deposited as fill subsequently reaches a condition such that it cannot be compacted in accordance with the requirements of the Contract, the Contractor shall either:
 - (i) make good by removing the material off the embankment either to tip or elsewhere until it is in a suitable physical condition for re-use, and replacing it with suitable material or
 - (ii) make good the material by mechanical or chemical means to improve its stability or
 - (iii) cease work on the material until its physical condition is again such that it can be compacted as described in the Contract.
- The particular method to be adopted shall be determined by the Architect.
7. Where special forms of compaction, adjacent to structures are required by the Contract, filling may proceed over widths less than the full width of the embankment or other fill area and in steps not exceeding the depth of one layer above the adjoining area of fill. In rockfill embankments, rocks shall be carefully packed for such distance from the structure as is required by the Contract.

11 COMPACTION OF EMBANKMENTS AND OTHER AREAS OF FILL

1. All materials used in embankments and as filling elsewhere shall be compacted as soon as practicable after deposition. Compaction shall be undertaken to the requirements of this Clause and Table 1, by approved plant, unless a variation thereof is approved by the Architect.
2. Variations from the methods given in Table 1, or the use of plant not included therein, will not be approved unless the Contractor demonstrates at site trials that a state of compaction is achieved by the alternative method equivalent to that obtained using the approved methods. The procedure to be adopted for these site trials shall be approved in advance by the Architect.
3. The Architect may at any time carry out comparative field density tests determined in accordance with B.S. 1377 test No.15 on material which he considers has been inadequately compacted. If the test results, when compared with the results of similar tests made on adjacent approved work in similar materials carried out in accordance with Table 1 show the state of compaction to be inadequate, the Contractor shall carry out such further work as may be directed.
4. When materials of widely divergent characteristics are used in embankments and fill areas they shall be spread and compacted in separate clearly defined areas in such a manner as to comply with the requirements of Table 1.

5. If more than one class of material is being used in such a way that it is not practicable to define the areas in which each class occurs, compaction plant shall be operated as if only the material which requires the greatest compactive effort is being compacted.
6. Definitions and Requirements associated with Table 1.
 - (i) the depth of compacted layer is the height by which an embankment is raised by each successive compacted layer.
 - (ii) number of passes is the number of times that each point on the surface of the layer being compacted has been traversed by the item of compaction plant.
 - (iii) the load (force) per 100mm width is the total weight (force) on the roll divided by the total roll width. Where a smooth-wheeled roller has more than one axle the machine will be assessed on the basis of the axle giving the highest value of load (force) per 25mm width.
 - (iv) vibratory rollers are self-propelled or towed having means of applying mechanical vibration to one or more rolls.
 - (a) The requirements for vibratory rollers are based on the use of the lowest gear on a self-propelled machine and a towing speed of 30-40 metres per minute for a towed machine. If higher gears or speeds are used an increased number of passes shall be provided in proportion to the increase in speed of travel.
 - (b) Vibratory rollers operating without their vibration mechanism in use will be classified as smooth-wheeled rollers.
 - (c) Vibratory rollers shall be operated with their vibration mechanism operating only at the frequency of vibration recommended by the manufacturers. All such roller shall be equipped with a device automatically indicating the frequency at which the mechanism is operating.
 - (v) vibrating-plate compactors are machines having a baseplate to which is attached a source of vibration consisting of one or two eccentrically-weighted shafts.
 - (a) The Static pressure under the plate of a vibrating-plate compactor is calculated by dividing the total weight (Mass (kg) x 98.1) of the machine in working order by the area in square centimetres in contact with compacted soil.
 - (b) Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the Manufacturer. They shall normally be operated at travelling speeds of less than 15 metres per minute but if higher speeds are necessary the number of passes shall be increased in proportion to the increase in speed of travel.
 - (vi) vibro-tampers are machines in which an engine-driven reciprocating mechanism acts on a spring system, through which oscillations are set up in a baseplate.

- (vii) Power rammers are machines which are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the operator. In the case of power rammers one pass will be considered as made when the compacting shoe has made one strike on the area in question.
- (viii) for items marked * the rollers shall be towed by track-laying tractors. Self-propelled rollers are unsuitable.

12 EMBANKMENTS AND OTHER AREAS TO FILL TO BE KEPT FREE FROM WATER

1. The Contractor shall arrange for the rapid dispersal of water, shed on to the embankments and other areas of fill or completed formation of access roads during construction or which enters such works from any source, and when practicable the water shall be discharged into the permanent outfall for the pipe drainage system. Adequate means for trapping silt shall be provided on temporary systems discharging into permanent drainage systems.
2. The Contractor shall provide where necessary temporary water courses, ditches, drains, pumping or other means of maintaining the earthworks free from water. Such provision shall include carrying out the work in such a manner that their surfaces have at all times a sufficient minimum crossfall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

13 WATERWORKS

1. Excavations carried out in the diversion, enlargement, deepening or straightening of watercourses shall include the operations of any necessary trimming of slopes, grading of beds, disposal of excavated materials and pumping, timbering works and materials necessary for dealing with the flow of water.
2. The beds and sloping sides of watercourses shall be protected against the action of water as provided for in the contract.

14 FILLING EXISTING WATERCOURSES

1. Where watercourses have to be diverted from the sites of embankments or other works, the original channels shall be cleared of all vegetable growths and soft deposits and shall be connected to a Surface Water Sewer where directed in the Contract.

15 CLEARING EXISTING DITCHES

1. Existing ditches shall, where shown in the Contract, be cleared by removing vegetable growths and deposits. The sides shall be trimmed throughout and the bottoms uniformly graded and the ditches kept clean and maintained for the period of execution of the works. Material removed from existing ditches shall be disposed of in tips outside the Site provided by the Contractor. Ditches which cross under carriageways shall be treated in accordance with Clauses 18 and Clauses 19 of the specification for "Pipelaying and Jointing".

3 MATERIALS FOR ROADS AND SEWERS

SPECIFICATION FOR MATERIALS FOR ROADS AND SEWERS

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PREAMBLE:

This specification contains five pages.

Where the contract to which this specification is being applied is of any form other than the RIAI Standard Form of Contract, then all references herein to 'the Employer's Representative ' shall be deemed to be replaced by an equivalent reference to 'DBFL Consulting Engineers'.

References herein to Irish, British or other National Standards of Practice do not give year of issue or dates of amendment. The latest relevant published version including any relevant amendments at date of invitation to tender shall apply.

Where a Standard or Code of Practice has been superseded the latest edition of the superseding publication shall apply.

References herein to the other specifications shall be to DBFL specifications unless noted otherwise.

Where the preambles to the Bills of Quantities and the Standards and Codes of Practice referred to herein are at variance, the more onerous requirement shall take precedence.

Requirements of the Building Regulations shall take precedence over any requirement referred to herein.

01 GENERAL

1. As far as practicable, materials and equipment required for the works shall be of Irish origin and manufacture and shall comply with the standards quoted.
2. All materials which the Contractor proposes to use in the construction of the work shall comply with the requirements of the Irish Standard Specification for such materials, if one has been published, or with the appropriate British Standard Specification of most recent edition. If no appropriate Standard Specification has been published the material shall be the best of its kind available and to the Employer's Representative 's approval.
3. As soon as possible after the Contract has been awarded, the Contractor shall submit to the Employer's Representative a list of the suppliers from whom he proposes to purchase the materials necessary for the execution of the works. Each supplier must be willing to admit the Employer's Representative to his premises during ordinary working hours for the purpose of obtaining samples of the materials. Samples shall be taken in accordance with the relevant Standard where applicable. Materials subsequently supplied

shall conform within any specified tolerances to the quality of samples which have been approved by the Employer's Representative .

4. The information regarding the names of the suppliers may be submitted at different times, as may be convenient, but no sources of supply shall be changed without the Employer's Representative 's prior approval.
5. When any material or article is required to comply with a Standard, such material or article or its container shall bear the stamp of the registered certification trade mark of the Irish or British Standards Institution. Alternatively, the Contractor shall submit to the Employer's Representative test certificates furnished by the supplier or manufacturer of the material or article indicating compliance with relevant Irish or British Standards.
6. In every case where, in the Specification, materials, appliances or fittings of special design, manufacture or description or the names of manufacturers or agents are given, it is to be clearly understood that such references are only inserted for the guidance of Tenderers with regard to the nature and quality of the articles and services required which must, in all cases, be subject to the Employer's Representative 's approval.

02 AGGREGATES FOR CONCRETE

1. Aggregates for concrete shall consist of naturally occurring material complying with the requirements of IS5.
2. Flakiness index when determined by the sieve method described in BS812 shall not exceed 35 for any size of coarse aggregate.

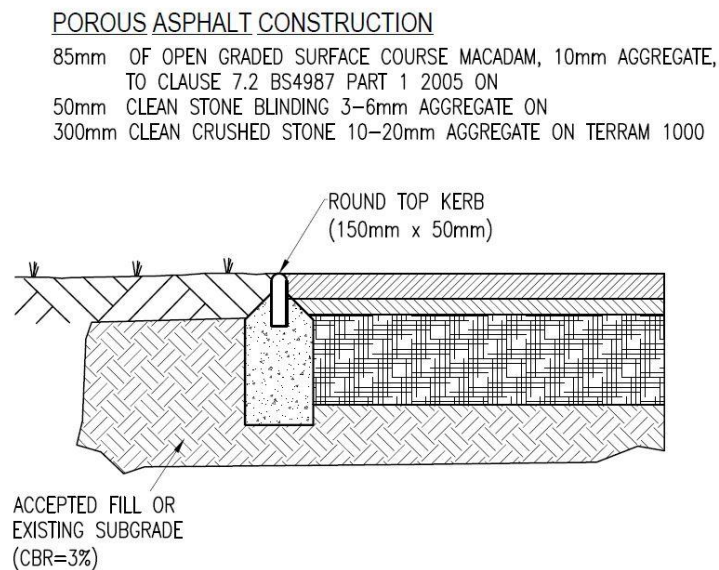
03 ASBESTOS CEMENT PIPES

1. Asbestos cement sewerage pipes and fittings shall comply with the requirements of BS3656 and asbestos cement sleeve joints with rubber rings with the requirements of BS2494 Class C.
2. Asbestos cement pressure pipes shall comply with the requirements of BS486. The pipes shall have plain ends and where ordered shall be dipped in bituminous solution. Fittings shall be of asbestos cement, cast iron complying with the requirements of BS78 Part 2 or mild steel complying with BS534.
3. Where possible, fittings shall have plain ends of an external diameter equal to that of the asbestos cement pipes and shall be suitable for use with an asbestos cement, cast iron or mild steel mechanical joint. Where compatible external diameters of fittings and pipes cannot be supplied, suitable stepped couplings of approved manufacture shall be used.
4. Cast iron and mild steel fittings shall be coated externally with bituminous composition. Fittings shall be coated internally if ordered with bituminous composition.

04 ASPHALT

1. Rolled Asphalt base course (binder) and wearing course (surface) shall be laid in accordance with BS594 and series 700 of the NRA Specification for Road Works..
2. Binder content and coarse aggregate shall be as specified in clause 910 of the NRA Specification for Road Works

3. Rolled Asphalt shall be laid and compacted to series 700 of the NRA Specification for Road Works.



Typical Porous Asphalt Construction Detail

05 BITUMEN MACADAM

1. Road base (base), base course (binder) and wearing course (surface) Dense Bitumen Macadam and Bitumen Macadam shall be made in accordance with BS4987 and should conform in respect of aggregate grading, binder content, grade of binder and mixing temperature with the appropriate table of that standard and as specified in the relevant clauses of series 900 of the NRA Specification for Road Works..
2. All Bitumen Macadam shall be laid and compacted to to series 700 of the NRA Specification for Road Works.
3. Bituminous Sealing Grit (in Surface Dressing)

Bituminous sealing grit shall be made with 3 millimetres nominal size crushed igneous rock, limestone or slag blended where necessary with clean sharp sand in accordance with BS4987: Appendix A/B, coated with 2 to 3 percent of straight-run or cut-back bitumen or alternatively fine cold asphalt to BS4987.
4. Tack Coat

Tack coat shall comply with Clause 920 of the NRA Specification for Road Works and consist of bituminous emulsion (anionic) complying with the requirements of BS434: Type IC having a viscosity under 5 deg. Engler and containing 35 percent bitumen.

06 CAST OR SPUN IRON PIPES AND JOINTS

1. Cast (spun) iron pipes shall comply with the requirements of BS1211. Fittings shall comply with the requirements of BS78: Part 2.

They shall be of the classes described in the Contract. Pipes and Fittings shall be coated externally with an approved bituminous composition except parts to be encased in concrete. Pipes and fittings shall be coated internally with an approved bituminous composition except where a special lining is detailed in the Contract.

2. Ductile iron pipes and fittings shall comply with the requirements of BS4772.
3. Insertion rings for flanged joints on pipes other than plastic pipes shall be of rubber reinforced with cotton, 3mm thick and shall comply with the requirements of BS5292.
4. Bolts, nuts and washers for flanged joints shall be cadmium plated and shall comply with the appropriate table of BS4504. Bolts shall have a minimum ultimate strength of 433 newtons per square millimetre.
5. Steel pipe ends, flanged specials and fittings shall be supplied complete with protective bolsters, caps or discs for protection in handling.

07 CEMENT GROUT

1. Cement grout shall consist of one part by volume Portland Cement mixed with one and a half parts by volume of water. The grout shall be used within one hour of mixing.

08 CEMENT LIME MORTAR

1. Cement lime mortar shall consist of :

1 part Portland Cement

1 part hydrated lime

6 parts natural sand

accurately gauged and mixed in an approved manner in small quantities. Any mortar which has begun to set or which has been mixed for a period of more than two hours shall be rejected.

09 CEMENT MORTAR

1. Cement Mortar shall consist of :

1 part Portland Cement

3 parts sand

accurately gauged and mixed in an approved manner in small quantities. Any mortar which has begun to set or which has been mixed for more than one hour shall be rejected.

10 CONCRETE BLOCKS

1. Concrete blocks shall be made to comply with requirements of IS20.

11 CONCRETE CLASSIFICATION

1. Concrete mixes shall be as described in the Contract and as set out in the specification for "Concrete Work".

12 CONCRETE SEWER PIPES

1. Concrete sewer pipes shall comply with IS6 and shall be of spigot and socket type with flexible joints unless otherwise specified in the Contract.
2. Unreinforced pipes with ogee joints, where specified in the contract for surface water drainage shall comply with IS166.

13 CURING COMPOUND

1. Aluminised curing compound shall, when applied at the rate specified for concrete roads by a mechanical sprayer, become stable and impervious to evaporation of water from the concrete surface within 60 minutes after application.
2. Test certificates, prepared by an approved testing laboratory, shall be supplied by the Contractor to show that the compound complies with Clause 2709 M.O.T. for a curing efficiency of 90% .
3. The curing compound shall contain sufficient flake aluminium in finely divided dispersion to produce a complete coverage of the sprayed surface with a metallic finish. The curing compound shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within three weeks after application.

14 DOWEL BARS

1. Dowel bars shall be mild steel bars, complying with BS4449 and shall be straight, free from oil, paint, dirt and loose dirt. The ends must be cleanly sawn and free from burrs. Size and manner of placing is as shown on Contract Drawings.

15 FELT

1. Self finished bitumen felt type 50/18 shall be in accordance with IS36 "Bituminous Roofing Felt".

16 FLAGS FOR PAVING

1. Precast Concrete paving flags shall comply with BS7263: Part 1. They shall be 50mm thick, and except where cutting is necessary, of a uniform width of 600mm, a minimum length of 450mm and a maximum length of 900mm. Flags which are cracked, chipped or imperfect in any way shall not be used.

17 GULLIES, FRAMES AND GRATINGS

1. Gulley gratings, frames and sealed chambers shall be cast-iron complying with BS497. Gulley grating, frame and hinge pin complete shall weigh not less than 82kg.

2. Precast concrete gullies shall be unreinforced and shall comply with the requirements of BS5911: Parts 1, 2, 3.

18 HARDCORE

1. Hardcore for filling shall consist of broken stone, brick or other material of approved quality, graded from 150mm to 50mm.

19 HYDRANTS

1. Fire hydrants shall comply with the requirements of BS750 and bear the markings BS750:1984. Depending on the requirements of the relevant Local Authority the hydrants shall be of the following types:

- (i) BS750:1984 Type 2 Screw down streamline pattern.
- (ii) BS750:1984 Type 2 except they shall have bayonet-lug type outlets.

Hydrants must be to the Employer's Representative 's approval. The following types will generally be acceptable:

- (a) Glenfield 750
- (b) Guest & Grimes with Mark 765 marked on the top flange of the gland and Mark 758 BS 750 marked on the bowl.

20 MANHOLES

1. Precast manholes shall be reinforced and shall comply with the requirements of BS5911:Part 1,2,3. The relevant absorption tests required by BS5911: Parts 1, 2, 3 shall be carried out on one section in every 50 of those required under the Contract.

21 MANHOLE FRAMES AND COVERS:

1. Covers and Frames shall meet the requirements of IS EN124 and the greater Dublin Regional Code of Practice for Drainage Works 6th Edition.
2. Circular covers and frame shall weigh not less than 242kg. Square cover and frame shall weigh not less than 233kg.

22 MANHOLE LADDERS

1. Manhole ladders and fixings shall be of mild steel complying with the requirements of BS5950 and galvanised after manufacture.
2. The stringers shall be 64mm by 19mm section and the rungs 25mm diameter.
3. The stringers shall be placed not less than 380mm apart with approved fixing brackets located at centres not exceeding 2 metres (minimum of two pairs per ladder). The rungs shall be at 230mm centres.

23 MANHOLE RUNGS

1. Manhole rungs shall be made from mild steel and all rungs shall be hot dip galvanised by the process described in BS1247.

24 MANHOLE STEP IRONS

1. When the depth of the manhole exceeds 1.2m galvanised mild steel step irons to BS1247 shall be built into the walls of the manhole. The steps shall be fixed at 300mm centres staggered over 300mm.

25 PIPE BEDDING MATERIAL (Non Concrete)

1. Granular bedding shall comply with the requirements of Clause 503 and Table 5/3 of the NRA Specification for Road Works. This shall only be applied in private areas

26 PROTECTIVE PASTE, MASTIC & TAPE FOR FERROUS JOINTS

1. The paste shall be a stable neutral compound based on saturated petroleum hydrocarbons, containing corrosion inhibitors and inert siliceous fillers and shall be adhesive and non-hardening.
2. The mastic shall be the paste as above but in addition shall contain vegetables and mineral bonding fibres and shall be self-supporting when applied.
3. The tape shall be an open-weave, inert, highly absorbent cloth impregnated and coated liberally on both sides with the paste.
4. These materials shall be made by an approved manufacturer.

PTFE TAPE

1. Polytetrafluoroethylene tape for thread sealing applications shall comply with the requirements of BS4375.
2. The tape shall be supplied on spools and shall be approximately 12mm wide by 0.075mm thick.
3. The tape shall be wound from the unscrewed portion of the bolt or pipe in a direction counter to the thread, with a 50 per cent overlap, to completely cover the threads without protruding at the end, and using sufficient tension for the tape to assume the form of the thread. Wrapping shall be done immediately prior to assembly of the joint.

27 READY-MIXED CONCRETE

1. Ready-mixed concrete shall comply with BS5328 and with the requirements of the Contract.

28 SADDLES

1. All saddles shall be cast as one piece and shall comprise a section of socket pipe with flange. The flange shall be placed so as to ensure that the end of the saddle does not project into the sewer.

29 SAFETICURBS

1. "Safeticurbs" shall be manufactured in accordance with BS7263: Part 1 and to the sections called for in the contract. They shall be laid to a true and even level by means of a 25mm mortar bed on a concrete foundation as detailed. The runs of "Safeticurbs" shall be laid with the necessary "Inspection Units", "Silt Boxes" and "Manhole Covers" and in accordance with the manufacturer's instructions and recommendations.

30 SLUICE VALVES

1. Sluice valves shall comply with the requirements of BS5163. The direction of opening shall be CLOCKWISE and Spindle caps shall be oval.

31 STEEL REINFORCEMENT

1. Mild steel bar reinforcement shall comply with the requirements of BS4449.
2. Cold worked steel bar reinforcement shall comply with the requirements of BS4449.
3. Steel fabric reinforcement shall comply with the requirements of BS4483. The wires shall be welded at the intersections and the fabric shall be delivered to the site as flat mats.
4. The Contractor shall procure and furnish to the Employer's Representative certificates from the manufacturers that all steel supplied is in accordance with these conditions.
5. Tying wire shall be either:-
 - (i) 1.625mm diam. of annealed iron wire or
 - (ii) 1.218mm diam. stainless steel wire.

32 SUB-GRADE /SUB-BASE SEPARATOR

1. Sub-grade /sub-base separator shall be terram 1000 or similar approved installed as per manufacturer's instructions.

33 SUB-BASE AND ROAD BASE (BASE)

1. Sub-base material shall be granular, frost resistant and comprise crushed rock in accordance with Clause 804 of the NRA Specification for Road Works. The material shall be well-graded and lie within the limits in Table 8/4 of the NRA Specification for Road Works. The particle size distribution shall be determined in accordance with the requirements of BS1377.
2. The material passing 500 micron sieve when tested in accordance with BS1377 shall be non-plastic.

34 UNPLASTICISED POLYVINYL CHLORIDE PIPES

1. Unplastered PVC pipes and specials shall comply with IS123.

35 WIRE

1. Barbed wire to IS121 shall be heavy gauge galvanised to BS443, 75mm pitch 4 pint.
2. Line wire to IS126 shall be 8.S.W.G. mild steel wire galvanised to BS443.
3. Tying wire to IS126 shall be 14 S.W.G. mild steel galvanised to BS443.

4 ROADS AND FOOTPATHS

SPECIFICATION FOR ROADS AND FOOTPATHS

CONTENTS:

PREAMBLE

- 01 Preparation and Surface Treatment of Formation
- 02 Horizontal Alignments and Surface Levels of Pavement Courses
- 03 Cold Weather Working
- 04 Use of Surfaces by Constructional Traffic
- 05 Sub-Base
- 06 Road base (base)
- 07 Road Gullies
- 08 Transporting, Laying and Compacting Pavement Materials Containing Bitumen Binder
- 09 Flexible Surfacing
- 10 Interlocking Concrete Pavers
- 11 Grass-Crete

PREAMBLE:

This specification contains six pages.

Where the contract to which this specification is being applied is of any form other than the RIAI Standard Form of Contract, then all references herein to 'the Employer's Representative ' shall be deemed to be replaced by an equivalent reference to 'DBFL Consulting Engineers'.

References herein to Irish, British or other National Standards of Practice do not give year of issue or dates of amendment. The latest relevant published version including any relevant amendments at date of invitation to tender shall apply.

Where a Standard or Code of Practice has been superseded the latest edition of the superseding publication shall apply.

References herein to other specifications shall be to DBFL specifications unless noted otherwise.

Where the preambles to the Bills of Quantities and the Standards and Codes of Practice referred to herein are at variance, the more onerous requirement shall take precedence.

Requirements of the Building Regulations shall take precedence over any requirement referred to herein.

01 PREPARATION AND SURFACE TREATMENT OF FORMATION

1. Connection, Crossings and Ducts

All sub-grade drainage, gulley and building connections, service crossings and ducts for services within the formation area shall be completed before preparation and treatment of the formation commences.

The Contractor shall give ample notice to Public utility Services (Gas Co., ESB, Waterworks Dept. etc.) to lay their service on the site of the proposed carriageway and complete their backfilling up to level of the top of pipe two weeks in advance of the preparation of the formation.

Type of duct, diameter, and depth of cover shall be as described in the Contract. A record of the position of all connections, crossings and ducts, measured from the nearest manhole, along with their description if requested shall be kept by the Contractor. The concrete channels on each side of carriageway shall be marked to show the position and description of the connection, crossing or duct.

Trenches shall be backfilled in accordance with the requirements of the Contract drawings and Clause 17 of the specification for "Pipelaying and Jointing". Backfilling around gulley pits, manholes etc. shall be graded stone to clause 804 of the NRA Specification for Road Works compacted by power rammer or vibratory roller in accordance with the requirements of Clause 09 of the specification for "Excavation and Backfilling".

2. Preparation and surface treatment of the formation shall be carried out only after the work specified in Clause 01.1 of this specification has been completed.

The sequence of operation shall be as follows:

(i) Formation and Soft Materials

- (a) All surfaces below roads and hardstandings shall, after reinstatement of any soft areas, be well cleaned and freed from mud and slurry.
- (b) The surface shall be compacted by 4 passes of a smooth-wheeled roller of 8-10 tonnes or equivalent.
- (c) The formation shall be regulated and trimmed to the requirements of Clause 02 of this specification.
- (d) The trimmed formation shall be rolled by 1 pass of a 2.5 tonnes smooth-wheeled roller or equivalent. construction of the sub-base or road base (base) shall follow immediately the completion of the formation.
- (e) If the completed formation is not immediately covered with sub-base or road base (base) material, it shall when directed be protected by sealing with cut-back bitumen of approved viscosity applied as follows:-
- (f) For a single coat the binder shall be applied at the rate of 1-1.2 litres/m² immediately blinded with 6mm size chippings at the rate of 5.5 - 6.7kg/m² and rolled with a smooth-wheeled or rubber tyred roller of 2.5 tonnes.
- (g) For two coats the binder shall be applied at a total rate spread of 1.7 litres/m². The first coat shall be applied at 0.91 litre/m², immediately blinded with 3mm size chippings at the rate of 5.5 - 6.7kg/m² and rolled as at (e) above. The second coat shall be as the first with the exception that the chippings shall be 6mm size. If the contractor allows the moisture content of accepted compact material to reach a value above the maximum permitted for the material under the Contract, the Contractor shall allow the material to revert to an acceptable moisture content and, if directed, make good at his own expense the surface by recompaction before laying the sub-base or road-base.

(ii) Formations or Rock Cuttings

The formation shall be thoroughly blinded with approved fine material to seal the surface, and shall then be completed in accordance with clauses 01(i)(c) & 01(i)(d) of this specification.

(iii) Formation of Rock Cuttings

Surface irregularities under formation remaining after trimming of the rock excavations shall be regulated to the requirements of Clause 02 of this specification with clean hard broken stone or leanmix concrete as required by the Contract.

02. HORIZONTAL ALIGNMENTS AND SURFACE LEVELS OF PAVEMENT COURSES

1. Horizontal alignments shall be determined from one edge of the roadway or hard standing pavement surface as shown in the Contract. This edge as constructed and all other parallel alignments shall be correct within a tolerance of $\pm 12\text{mm}$ therefrom.

2. Surface Levels of Pavement Courses

The levels of pavement courses and formation shall be determined from the true pavement surface, which shall be the surface of the wearing course for flexible pavements calculated from the vertical profiles and crossfalls as shown in the Contract. The vertical depth below the true pavement surface of any point on the construction surface of the formation or intermediate courses shall be within the following tolerances:

Formation/Capping	+ 0/- 50 mm
Sub-base	$\pm 20\text{ mm}$
Road-Base (base)	$\pm 12\text{ mm}$
Basecourse (binder)	$\pm 6\text{ mm}$
Wearing course (surface)	$\pm 6\text{ mm}$

3. The surface level of the laid wearing course shall not deviate vertically at any point from the true pavement surface by more than $\pm 6\text{ mm}$. However, for flexible pavements the adjacent tolerances shall not be applied so as to reduce the thickness of the wearing course by more than 6mm.
4. The laid roadway pavement wearing course (surface) and the basecourse (binder) surface shall be tested with a 3 metre straight edge parallel to the centre line of the road and shall have no greater depression under the straight edge than 3mm and 6mm respectively.

5. Rectification

Where any tolerance is exceeded the Contractor shall rectify the defective surface as follows:

(i) Formation Level

If the surface is too high it shall be trimmed and re-compacted in accordance with Clause 01 of this specification. If the surface is too low the deficiency shall be corrected by the addition of fresh suitable material of the same classification laid and compacted in accordance with Clause 01 of this specification.

(ii) Road base (base) and Sub Bases

The top 75mm of the defective area shall be scarified, reshaped, with added material as necessary, and re-compacted all in accordance with Clauses 05 and 06 of this specification.

(iii) Basecourse (binder) and Wearing Course (surface)

These shall have level or tolerance measurements made while the material is still warm and rectification, where necessary, carried out immediately. Otherwise the Employer's Representative may require the full depth of the layer removed over the defective area and replaced with fresh material laid and compacted in accordance with series 700 of the NRA Specification for Road Works

03 COLD WEATHER WORKING

1. No material in a frozen condition shall be incorporated in the works but shall instead be retained on Site for use if suitable when unfrozen.
2. Material for use in pavement courses shall not be laid on any surface which is frozen or covered with ice.
3. Laying of materials containing bitumen binders shall cease if the temperature of the surface to be covered is at or falls below 2 deg.C. Where, however, the surface is dry, unfrozen and free from ice, laying may proceed at temperatures at or above -1 deg.C. on a rising thermometer.

04 USE OF SURFACES BY CONSTRUCTIONAL TRAFFIC

1. Constructional traffic used on pavements under construction shall be suitable in relation to the courses it traverses so that damage is not caused to the sub-grade.
2. Where damage is caused to the formation of the sub-grade in strength or level the damaged area shall be excavated for an area and depth which shall be determined by the Employer's Representative and this area shall be filled to the required levels with broken stone of 50mm maximum size. (Typically capping material 6F2 to clause 613 of the NRA Specification for Road Works). The degree of compaction for this area shall be the same as that specified for the remainder of the formation. All this excavation and making good of damaged areas shall be carried out at the expense of the Contractor.
3. Where damage is caused to the sub-base the damaged area shall be made good in similar to above using the material of which the sub-base is composed.
4. The wheels or tracks of plant moving over the various pavement courses shall be kept free from deleterious materials.
5. Bituminous basecourse (binder) material shall be kept clean and uncontaminated for so long as it remains uncovered by a wearing course or surface treatment. The only traffic permitted access to base-course (binder) material shall be that engaged in laying and compacting the wearing course (surface) or, where the basecourse (binder) is to be blinded and/or surface dressed and engaged on such surface treatment. Should the basecourse (binder) become contaminated the Contractor shall make good by cleaning it to the satisfaction of the Employer's Representative and if this proves impracticable by removing the layer and replacing it in accordance with series 700 of the NRA Specification for Road Works.

05 SUB-BASE

1. Unless otherwise described in the Contract sub-base material shall be in accordance with Clause 33 of the specification for "Materials for Roads and Sewers" and shall be laid in layer or layers to have the total compacted thickness shown in the Contract.

2. The minimum compacted thickness of layer shall be 75mm and the maximum compacted thickness shall be 170mm.
3. All materials shall be placed and spread evenly. Spreading shall be undertaken concurrently with placing or without delay. Methods of spreading shall be to the Employer's Representative's approval.
4. As soon as possible after the material has been spread compaction shall be completed in accordance with Table 8/1 of NRA Specification for Road Works. Special care shall be taken to obtain full compaction in the vicinity of both longitudinal and transverse joints. The surface of any layer of material on completion of compaction shall be well closed and free from movement under compaction plant and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.
5. The sub-base must be fully prepared and approved by the Employer's Representative before road base (base) construction commences.

06 ROAD BASE (BASE)

1.
 - (i) Granular road base (base) shall be in accordance with Clause 33 of the specification for "Materials for roads and sewers".
 - (ii) Bitumen road base (base) shall be in accordance with Clause 05 of the specification for "Materials for roads and sewers".
 - (ii) Lean base macadam shall comply with B.S. 4987 with modification to grading and to blinder contents as shown in Table 2 of this specification:

TABLE 2.	
LEAN BASE MACADAM GRADING	
SIEVE SIZE mm	% PASSING
76	100
40	60 - 80
20	30 - 50
10	5 - 15
0.1	1.5

2. The road base (base) shall be laid in layer or layers to have the total compacted thickness shown in the Contract.
3. The minimum compacted thickness of granular road base (base) shall be 75mm and the maximum compacted thickness shall be 170mm.

4. Bitumen road base (base) shall be laid in one layer to maximum thickness of 100mm assuming a 32 maximum aggregate size in accordance with table 9/1 of the NRA Specification for Road Works.
5. All road base (base) materials shall be placed and spread evenly by paver machine or as agreed with the Employer's Representative .
6. Transport laying and compacting of road base (base) containing bitumen binders shall conform with Series 700 of the NRA specification for Road Works.
7. Granular road base (base) material shall be spread and compacted in conformity with Clauses 05.3, 05.4.

07 ROAD GULLIES

1. Surface water gullies shall comprise a rectangular chamber to dimensions & detail shown on Contract Drawings and as represented in the Greater Dublin Regional Code of Practice for Drainage Works 6th Edition
 - (i) Built of 225mm concrete block in compliance with I.S.20, in cement mortar on mass concrete bed as specified in the specification for "Concrete Work", or
 - (ii) Built in mass concrete 225mm thick on concrete bed, or
 - (iii) Precast chambers may be used if approved by the Employer's Representative and on only in areas not under the charge of Dublin City Council.
2. The outlet pipe from the chamber shall be as high as possible above sump level to facilitate rodding and shall be trimmed to the inside face of the wall of the chamber into which it is built.
3. The gully grating and frame shall be set flush with the level of the channel and the transverse bars of the grating shall be at right angles to the line with the hinged end of the grating on the side of approaching traffic.

08 TRANSPORTING, LAYING, COMPACTING PAVEMENT MATERIALS CONTAINING BITUMEN BINDER

1. Bituminous materials shall be transported in clean vehicles and shall be covered over when in transit or awaiting tipping. The use of dust, coated dust, oil or water on the interior of the vehicles to facilitate discharge of the mixed materials is permissible but the amount shall be kept to a minimum, and any excess shall be removed by tipping or brushing.
2. Whenever practicable bituminous macadam shall be spread, levelled and tamped by approved self-propelled pavers. The mixed materials shall be delivered with minimum delay to the paver and in such quantity as to permit its continuous operation and it shall be so operated whenever practicable.
3. The rate of travel of the paver and its method of operation shall be adjusted to ensure an even and uniform flow of material across the full laying width, freedom from dragging or tearing of the material and minimum segregation.
4. The material shall be laid generally in conformity with the recommendations for laying in the British Standard to which it has been made subject and also to the following additional overriding requirements.
5. Hand laying of any bituminous material will be permitted only the following circumstances:
 - (i) for laying regulating courses of irregular shape and varying thickness

- (ii) in confined spaces where it is impracticable for a paver to operate
 - (iii) for footways
 - (iv) where directed in the Contract.
6. Material shall be compacted as soon as rolling can be effected without causing undue displacement of the mixed material and while this has at least the minimum rolling temperature stated in the appropriate British Standard. The material shall be uniformly compacted by a 8 - 10 tonnes smooth steel wheeled roller having a width of roll not less than 450mm. The forces per unit width of the rear roller shall not be less than that 53 kN/mm or 302 lb/in.
7. The compaction achieved will depend on the workability and temperature of the material at the time of rolling, which shall commence as soon as is possible without causing undue displacement of the coated macadam, and should continue until all roller marks have disappeared. Adequate compaction is essential to ensure full strength and in the case of dense road base (base) macadam and dense basecourse (binder) macadam these materials (typically DBM50) shall be compacted at temperatures not less than 105 degrees C. The temperature of these mixed materials as delivered to the laying site shall be between 125 and 150 degrees C.
- Rolling shall proceed in a longitudinal direction with the large rolls nearer the spreaders or laying machine, working from the side to the centre of the lane, overlapping on successive passes by at least one half of the width of the large roll. The roller shall be fitted with a quick reverse and smooth-acting clutch, operated by an experienced driver. Points of reversing must be staggered.
- The number of rollers employed will depend on the area to be covered daily and shall be sufficient to enable the rollers while travelling at a slow but steady speed to make sufficient passes to adequately compact the coated macadam.
- Rollers shall not stand on freshly laid coated macadam while there is a risk it might deform and all changes of lateral direction shall be made on cool material.
8. Asphalt wearing courses (surface) shall be compacted at temperatures not less than 105 degrees C. Dense Macadam wearing courses (surface) shall be compacted at temperatures not less than 85 degrees C.
- Reference should be made to table 9/2 of the NRA Specification for Road Works
9. A mechanical chipping spreader capable of operating with even distribution shall be used for applying coated chippings to the surface of wearing course material.
- The addition of chippings by hand shall be limited to the following circumstances.
- (i) to confined spaces where it is impracticable for a chipping spreader to operate.
 - (ii) as a temporary expedient when adjustments have to be made to the distribution mechanism.

-
- (iii) to correct unevenness in the distribution of chippings.
10. All chippings shall be applied uniformly to the surface and be rolled into the wearing course in such a manner that they are effectively held.
11. Hand-raking of wearing course material which has been laid by a paver and the addition of such material by hand-spreading to the paved area for adjustment of level will be permitted only in the following circumstances.
- (i) at the edges of the layers of material and at gullies and manholes.
- (ii) where otherwise directed by the Employer's Representative .
12. Hand laid work shall conform to all the specification requirements of this Clause except those relating to the manner of operating pavers.
13. When laying wearing courses the Contractors shall so organise his work that as far as possible there are no longitudinal joints left at the end of any day's work.
- Where joints between laying widths or transverse joints have to be made, the material shall be fully compacted and the joint made flush by cutting back the exposed joints to a vertical face of not less than the specified thickness, discarding all loosened material and coating the vertical face completely with a grade of hot bitumen suitable for the purpose before the next width is laid. A similar coating shall be applied to edges of projecting features, eg. kerbs, manholes.
14. All joints shall be offset at least 300mm from parallel joints in the layer beneath.
15. Basecourse material shall not remain uncovered by either the wearing course or surface treatment whichever is specified in the Contract for more than three consecutive days after being laid. Consent may be given for the extension of this period by the minimum amount of time necessary if compliance therewith is impracticable because of weather conditions or for any other reasons such as awaiting the results of tests made.

09 FLEXIBLE SURFACING

1. Regulating Course

Regulating course material shall be made and laid in accordance with the requirements for either the basecourse (binder) or road base (base) materials as described in the Contract.

2. Macadam

Where bituminous base and wearing courses are not to be applied, the surface of the road base (base) shall be thoroughly and uniformly blinded with graded fine aggregate passing the 5mm British Standard sieve size, of the same material as the road base (base), and compacted by an 8 - 10 tonnes roller to a firm even surface. Where directed by the Contract or by the Employer's Representative, the blinding material shall be watered and swept over the road base (base) surface ahead of rolling. Upon completion excess fines shall be lightly brushed off and removed.

3. Two Course Bitumen Macadam

This material shall be made in accordance with Clause 04.1 of the specification for "Materials" laid to series 700 of the NRA Specification for Road Works, to give compacted thickness of basecourse (binder) and of wearing course (surface) as shown in the Contract.

10 INTERLOCKING CONCRETE PAVERS

1. General

The construction of the areas of interlocking concrete pavers shall be as specified in the contract drawings. In the absence of detail shall be in accordance with the BRL General Specification Phase 4 (Oct 2009)

2. Sub-base

The construction of the sub-base shall be as shown on the contract drawings and shall be carried out in accordance with clause 05 of this specification.

The surface of the sub-base shall be close-textured to prevent any downward migration of sand from the bedding course. Final surface profiles shall be incorporated in the surface of the sub-base.

3. Bedding Course

The sand for the bedding course shall be zone (2) or zone (3) washed sharp sand to BS882, or Laying course sand grading C in table 5 of IS5. The sand shall not contain more than 3% by weight of silt and clay and not more than 10% shall be retained on a 5mm sieve.

The compacted thickness of bedding sand shall be 30mm. The precise amount of surcharge required to give the compacted thickness shall be determined by trial and error on site before any final laying commences.

A prepared area of 40 sq.m. of bedding course shall be maintained in advance of the paving operation. Care shall be taken to avoid disturbance of the prepared bedding course prior to construction of the wearing surface. A flat edge rake may, however, be used to repair the surface if required.

4. Wearing Course (surface)

The wearing course shall be formed by laying close-butted pavers on the uncompacted sand bedding course to a pattern determined by the contract drawings.

Paving shall be commenced from a straight starting edge. Infill pieces shall be incorporated along the starting edge as the work proceeds, to establish the bond pattern.

Pavers shall be supplied to the advancing laying face over the new work, and stacked approximately 1m back from the leading edge. Care shall be taken to avoid the use of heavy plant running over the uncompacted area of the wearing surface.

As the area of paving increases, the pattern should be checked continually. Cutting of pavers, where necessary, shall only be allowed using a method which has the prior approval of the Employer's Representative.

5. Compaction and Jointing

Compaction of the wearing course shall be carried out using plate compactors having a centrifugal force of between 7 and 16 kN, and having a plate area of between 0.2 and 0.4 sq.m. A frequency of 75 and 100 Hz is required. Compaction and joint filling shall not be commenced in a particular area until the edge infill has been completed. Compaction should be carried out after the completion of 40 sq.m. The pavement shall not be compacted within 1m of an unrestrained edge.

Jointing sand shall have a maximum particle size of 1mm in accordance with grading F in table 5 of IS 5. However, if such sand is not available, bedding sand shall be brushed across the surface and the "fine fraction" allowed to settle into the joints. After completion of compaction and joint infill, the pavement may be immediately trafficked.

6. Surface Tolerances

The level of two adjacent units shall not differ by more than 2mm, and the maximum deviation under a 3 metre straight edge shall not exceed 10mm. Finished levels shall be within 12mm of the specified levels.

11 GRASS-CRETE

1. TECHNICAL DETAILS

Unit Size:	600 x 600mm
Depth:	150mm
Formers per m ²	2.78
Concrete coverage	11.50m ² /m ³
Topsoil coverage	12m ² /m ³

STANDARD SPECIFICATION

GRASSCRETE® GC2 formers 150mm deep laid on a consolidated sub-base minimum 150mm to Specification for Highway Works Clause 803 with a 20mm blinding layer of sand. Steel mesh reinforcement to BS4483 reference A252 weighing 3.95kg/m². Concrete 30MN/m² at 28 days with an air entrainment of 3%.

10mm maximum aggregate and a slump of 100mm* placed around formers and mesh. Level surface, melt exposed tops of formers and fill voids with fine friable soil. After settlement sow either GRASSMIX No 1, 2 or 3 at a rate of 50g/m² and top up with fine friable topsoil. Apply fertiliser as necessary. All in accordance with the manufacturer's instructions.

5 PIPELAYING AND JOINTING

SPECIFICATION FOR PIPELAYING AND JOINTING

CONTENTS:

PREAMBLE

- 01 Types of Pipes
- 02 Pipe Trenches
- 03 Excavation for Pipelines
- 04 Explosives & Basting
- 05 Pipelaying - General
- 06 Withdrawal of Supports
- 07 Bedding & Protecting Pipes
- 08 Plugs
- 09 Gaps for Valves etc
- 10 Jointing Pipes
- 11 Flanged Joints
- 12 Cast Iron Joint Fittings
- 13 Cement Mortar Joints
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- 16 Cutting Pipes
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- 18 Ditches
- 19 Land Drains
- 20 Connection to Sewers
- 21 Setting Valves etc
- 22 Cleaning Pipelines etc
- 23 Testing of Sewers & Drains
- 24 Inspection & Testing of Water Mains
- 25 Details
- 26 Surface Water Attenuation Storage & Infiltration System
- 27 Rain Water Harvesting Grp Storage Tank
- 28 Rain Water Leaf Filter

29	Rain Water Non-Return Valve
30	Vortex Flow Control
31	Penstocks & Actuators

PREAMBLE:

This specification contains eleven pages..

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Where the preambles to the Bills of Quantities and the Standards and Codes of Practice referred to herein are at variance, the more onerous requirement shall take precedence.

Requirements of the Building Regulations shall take precedence over any requirement referred to herein.

01 TYPES OF PIPES

1. The Contractor shall construct the pipelines using the design of pipe, bed, haunch and surround shown in the Contract and illustrated on the Contract drawings.
2. Where the Contractor wishes to use a type of pipe not manufactured in the minimum internal diameter indicated in the Contract, he may substitute the next larger diameter manufactured, subject to compliance with the design requirements, clearance and cover. The Contractor shall not use pipes and fittings supplied by more than one manufacturer without approval.
3. "Rigid pipes" shall mean pipes of cast or spun iron, concrete, asbestos cement, clay or similar materials.
4. "Flexible pipes" shall mean pipes of steel, PVC or other plastic, pitch fibre, ductile iron or similar materials.
5. "Rigid joints" shall mean joints made by bolting together flanges integral with the barrels of the pipes, by welding together the barrels of the pipes, by caulking sockets with non-deformable material, such as, cement mortar, or by similar techniques.
6. "Flexible joints" shall mean joints made with factory made jointing materials, loose collars, rubber rings etc., and which allow some degree of flexing, however small, between adjacent pipes.

02 PIPE TRENCHES

1. The definition of Clause 01.1 of the specification for "Excavation and Backfilling" read with the particular requirements of this specification shall apply to pipe trenches.

03 EXCAVATION FOR PIPELINES

1. Top soil shall be stripped, laid aside and kept separate from other excavated materials. Where directed, turf shall be stripped by hand and carefully stacked. Road bottoming and surfacing material which is approved as suitable for re-use shall be laid aside and kept separate from other excavated materials.
2. Trenches for pipes, other than those forming part of a french drain, shall be excavated to a sufficient depth and width subject to the restriction in Clause 03.4 of this specification, to enable the pipe & the specified or other approved joint, bed, haunch & surround to be accommodated.
3. The width of trenches shall be within the limits of width shown in Table 1 or such other width shown in the Contract up to a minimum of 300mm above the top of the pipe barrel. Battering the sides of trenches shall only be permitted above this level where approved by the Employer's Representative .
4. The Contractor shall provide whatever additional pipe protection is necessary in the opinion of the Employer's Representative should the specified maximum width be exceeded due to his method of working.
5. Where rock or boulders are present in pipe trenches the sides of the trench shall be so trimmed that when the pipe is laid to the correct level and alignment, no projection of rock comes within 100 mm of the outside of the pipe barrel at any point.
6. Where rock is found in the bottom of trenches, the trenches shall be excavated to the additional depth necessary to allow for the required bedding as presented on the contract drawings (minimum 150mm)..
7. Trenches for pipes carrying water under pressure, except where otherwise required by the Contract, shall be excavated to a sufficient depth to ensure, after consolidation of the refilling, a normal minimum depth of cover of 750mm from ground surface to the top of the pipe. Where the pipeline is required to be laid to a depth which does not permit this condition to be fulfilled the ground surface shall be made up locally with banking as directed.
8. The Contractor shall fill up any excessive depth of trench arising from his method of working. with either well compacted Type B granular bedding material to Clause 33 of the specification for "Materials for Roads and Sewers" or with leanmix concrete where ordered by the Employer's Representative.

TABLE 1. TRENCH WIDTH LIMITS				
NOMINAL mm	INTERNAL DIAMETER	MINIMUM TRENCH WIDTH mm		MAXIMUM TRENCH WIDTH mm
	100	450		650
	150	500		700
	225	600		800
	300	700		900

375	950	1150
450	1050	1250
525	1150	1350
600	1250	1450
675	1350	1550
750	1400	1600
825	1500	1700
900	1950	2150
1050	2100	2300
1200	2300	2500
Above 1200	Outside diameter of pipe plus 800mm	Outside diameter of pipe plus 1000mm

9. Trench Widths

From the bottom of the trench to a level 300mm above the crown of the pipe, trench widths shall not be less than the minimum nor greater than the maximum figures shown in the tables above. Where the Contractor excavates the trench to a width greater than the maximum figure from the bottom of the trench to a level 300mm above crown of pipe, and in the opinion of the Employer's Representative such extra width will result in more load being placed on the pipe than it can safely carry, the Contractor shall provide, at his own expense, any extra items which the Engineer may direct. Such items may include substitution of a higher class pipe, extra granular bed cradle and surround, or extra concrete bed cradle and surround with or without reinforcement. Any costs resulting from such delay shall be the responsibility of the Contractor.

The minimum width is that width between the faces of the soil required to ensure the correct placing and compaction of bedding materials equally on either side of the pipe with sheeting and supports outside this width.

The maximum width is that width between the faces of the soil which has been used in the structural design of the pipeline and it includes an allowance for sheeting and tolerance.

10. Where the trench formation is in ground that, in the opinion of the Employer's Representative, is too soft to afford proper support to the pipes:
- (i) The trench shall be excavated down to solid ground and the extra depth shall be refilled with concrete, Type B granular bedding material, gravel or broken stone, as the Employer's Representative directs, well compacted to form an even bed.

- (ii) The Contractor shall avoid unduly disturbing the finished trench formation and shall make good disturbed areas and excavate any wet or puddled material which might result from his failure to do so. Voids shall be made good as in Clause 03.10.i of this specification.
- 11. Where directed, trenches close to existing structures shall be opened in short lengths and refilled or partly filled with leanmix concrete or other approved material.
- 12. The material excavated in forming pipelines shall, if unsuitable, as defined in Clause 01.1 of the specification for "Excavation and Backfilling" be run to spoil and replaced with suitable material as so defined. Suitable material shall be set aside for use as backfill.
- 13. All surplus excavated material shall be disposed of in accordance with Clause 01.5 of the specification for "Excavation and Backfilling".

04 EXPLOSIVES AND BLASTING

- 1. The Contractor must comply with all current regulations about handling, transport, use and storage of explosives. Explosives may only be handled by experienced shotfirers and shall be used in the quantities and manner recommended by the manufacturers. The Contractor shall ensure that there is no unauthorised issue or improper use of explosives brought on the site.
- 2. The Employer's Representative's written permission shall be obtained for each location or series of locations where the Contractor wishes to use more than 9 kg of explosives in one blast. Such permission shall not in any way relieve the Contractor of his liabilities under the Conditions of Contract or under the law in general.
- 3. When blasting is carried out, the Contractor shall ensure by adherence to proper safety distances and by the use of heavy blasting mats where necessary to prevent the dispersal of material, that no damage is caused to persons or property on or off site. Special care shall be taken when blasting in wet ground to ensure that individual explosions are reduced to such a size as to preclude damage to any buildings or structures. Plaster shooting will not be permitted within 360 metres of any buildings or structure.

05 PIPELAYING

- 1. Flat braided steel wire slings or band slings shall be used for slinging all pipes except externally coated pipes and plastic pipes for which only special band slings not less than 300mm wide shall be used. Chain or rope slings, hooks or other devices working on scissor or grap principles shall not be used.
- 2. Subject to the requirements or inspection before acceptance, protective bolsters, caps or discs on the ends of flanges or pipes, specials or fittings shall not be removed until the pipes, specials, or fittings are about to be lowered into the trench.
- 3. Before a pipe is lowered into the trench, it shall be thoroughly examined to ensure that the internal coating or lining and outer coating or sheathing are undamaged. Where necessary, the interiors of pipes, specials and fittings shall be carefully brushed clean. Any damaged parts of the coatings or linings shall, before a pipe is used, be made good as directed.
- 4. Pipelaying shall not commence until the bottom of the trench and the pipe bed are approved.

5. Pipes shall be brought to the correct alignment and inclination concentric with pipes already laid.
6. All pipes less than 600mm in diameter with flexible joints shall be accurately marked prior to laying to ensure that the correct gap is left in the joint.
7. PVC pipes shall be stored and handled carefully and shall not be subjected to stresses which will include permanent set or ovality.
8. PVC pipes shall be protected from the effects of temperature in accordance with the manufacturer's recommendations and shall not be laid in freezing temperatures.
9. Pipelaying shall always commence at the lowest invert point and work in the direction of increasing level.

06 WITHDRAWAL OF SUPPORTS

1. During the placing of bedding, haunching, surrounding or anchoring material, temporary side supports and sheeting shall be removed except where directed to be left and the full width of the trench shall be infilled with bedding, haunching, surrounding or anchoring materials.

07 BEDDING AND PROTECTING PIPES

1. Bedding, haunching, surrounding and anchoring pipes shall be of the arrangements and dimensions shown in the Contract drawings
2. A cavity of adequate size shall be left in the pipe bed at each joint and at each sling position.
3. The bottom of the trench or surface of the bed shall be finished to a smooth even surface at the correct levels to permit the barrel of the pipe to be solidly and evenly bedded throughout its whole length between joint and sling holes.
4. The preparation of the trench bottom or surface of the bed shall be completed for a least one full pipe length in advance of the pipelaying, except where in exceptional circumstances another arrangement is approved.
5. No bedding material shall be placed in trenches containing water.
6. Where granular bedding is to be used, stones, bricks or similar materials shall not be used below or against the pipes to locate them in position in the trench or to level the pipes. Sufficient of the infill materials shall be placed around the barrels of pipes to prevent movement.
7. Where directed, puddle clay dams 500mm thick shall be constructed around the pipe and across the trench as haunching and surrounding proceeds. The dams shall be at intervals not exceeding 30 metres or as directed, and their height shall be determined by the Employer's Representative .
8. Where indicated by the requirements for testing pipelines, the method of haunching and surrounding pipes shall be modified to leave pipe joints exposed.

Granular Bedding and Surround for Rigid Pipes (Private Areas Only)

9. Where rigid pipes, concrete pipes, A.C. etc. are to be bedded on granular material, this should comply with clause 25 of the specification for "Materials for Roads and Sewers"

10. The bedding material shall be placed by hand in the excavation below the level of the pipe barrels and shall be tamped and rammed by hand in layers not exceeding 150mm thick before compaction, to provide a dense well compacted bed free from soft spots throughout the length of the pipeline between joint and sling holes.
11. After the pipes have been properly bedded and tested granular material, as bedding above, shall be carefully placed into the spaces between the pipe and the sides of the trench to the level of half pipe. The material shall be thoroughly packed and rammed by careful hand tamping in layers not exceeding 150mm thick before compaction. The placing and the tamping of the material shall proceed equally on both sides of the pipe.
12. Granular material to Clause 25 of the specification for "Materials for Roads and Sewers" shall be placed into the spaces between the pipe and the sides of the trench to a level of 100mm minimum and 300mm maximum above the crown of the pipe. The fill shall be thoroughly packed and rammed by careful hand tamping in layers not exceeding 150mm thick before compaction. The placing and the tamping of the material shall proceed equally on both sides of the pipe.
13. Selected excavated material over the full width of the trench in layers not exceeding 300mm deep after compaction shall be placed above the bed and surround to the pipe, each layer being lightly tamped by hand, to the underside of the surface formation subject to the requirements of clause 17

Granular Bedding and Surround for Flexible Pipes (Private Areas Only)

14. Flexible pipes of PVC shall be bedded on granular material, this should comply with clause 25 of the specification for "Materials for Roads and Sewers"
15. The bedding material shall be placed by hand in the excavation below the level of the pipe barrels and shall be tamped and rammed by hand in layers not exceeding 150mm thick before compaction, to provide a dense well compacted bed free from soft spots throughout the length of the pipeline between joint and sling holes.
16. After the pipes have been properly bedded and tested granular material, as bedding above, shall be carefully placed into the spaces between the pipe and the sides of the trench to the level of half pipe. The material shall be thoroughly packed and rammed by careful hand tamping in layers not exceeding 150mm thick before compaction. The placing and the tamping of the material shall proceed equally on both sides of the pipe.
17. Selected excavated material over the full width of the trench in layers not exceeding 300mm deep after compaction shall be placed above the bed and surround to the pipe, each layer being lightly tamped by hand, to the underside of the surface formation subject to the requirements of clause 17

Concrete Bedding, Haunching, Surrounding and Anchoring

18. Concrete for bedding, haunching, and surround shall be as specified in the specification for "Concrete Work". After 24 hours a 300mm layer of selected backfilling may be placed over the pipe but no further backfilling may be placed until the concrete strength has reached 8 N/mm².
19. The concrete bed shall be set and hard for at least 24 hours before pipe laying commences.
20. Placing of concrete for haunching or surround shall not commence until the work has been approved by the Employer's Representative .
21. Concrete laid in haunching or surround shall be firmly bonded to the previously laid bed so that the whole is solid and homogenous. The upper surface of the concrete shall be struck off with a screed and neatly finished.

22. Where the concrete is not carried up to the crown of the pipe, the spaces between the barrel of the pipe and the sides of the trench shall be filled using Type B Granular fill material to clause 33 of the specification for "Materials for Roads and Sewers", in layers not exceeding 150mm after compaction over the full width of the trench, and lightly tamped by hand, until 300mm above the crown of the pipe. The remaining backfill to the trench shall be in accordance with the contract drawings, subject to the requirements of clause 17
23. Rapid hardening or high alumina cement shall not be used in concrete in contact with PVC pipes.
24. PVC pipes shall be wrapped in polythene sheet or roofing felt about 2 mm thick before being haunched or anchored in concrete.
25. Concrete anchor blocks of Mass Concrete as specified the specification for "Concrete Work" shall be placed at all bends greater than 22.5 deg. to prevent movement of pipelines due to thrust from water pressure. The anchor blocks in trenches shall be placed against undisturbed ground. Any loose or disturbed material shall be removed immediately before the concrete is placed and the side of the trench which receives the thrust shall be cut vertically.
26. Concrete anchorages to water-mains shall be taken below the pipe invert as shown in the Contract and the concrete shall be placed to support the circumference of the pipe. PVC pipe shall not be encased in concrete, but ductile iron pipes may be encased.

08 PLUGS

1. Immediately after laying, the open end of a pipe shall be sealed with a wooden plug or approved stopper of appropriate size to prevent the entry of material which might contaminate the pipeline, damage the linings, obstruct the waterway or affect the workings of valves, meters etc. Plugs shall be un-perforated and shall be shaped to fit neatly to prevent water ingress.
2. Water pipes and fittings 150mm and under in diameter shall have a brush equal in diameter to the internal bore of the pipe drawn through them as the work proceeds. The brush shall not be removed from the pipeline from commencement until completion.
3. The plugs in sewers may, with the Employer's Representative's approval, be provided with small holes for drainage purposes, but water from the trench excavation which is heavily charged with silt shall not be allowed to gain access to the pipe.
4. Where work is interrupted for a period, the plugs left in position shall be regularly inspected for their fixing to ensure that there has been no tampering by unauthorised persons. Whenever any plug is removed, the immediate length of pipe shall be examined for dirt or obstructions and shall be cleaned as required.
5. Adequate precautions shall be taken by way of backfilling or other means to anchor each pipe securely to prevent flotation of the pipeline in the event of the trench being flooded.

09 GAPS FOR VALVES ETC

1. If the normal continuity of construction requires to be interrupted pending the delivery of valves or specials, the exact extent of the temporary gaps to be left shall be predetermined to the Employer's Representative's approval. The contractor shall submit dimensioned sketches for approval, showing details of the pipe and jointing arrangements to be adopted to effect ultimate closure. Care shall be taken to preserve the accurate alignment of the pipeline across all such temporary gaps.

10 JOINTING PIPES - GENERAL

1. Joints shall be made strictly in accordance with the manufacturer's instructions. The Contractor shall make use of the technical advisory services offered by manufacturers for instructing pipe jointers in the methods of assembling joints. Where manufacturers recommend the use of special jointing tackles, the Contractor shall use these for the assembly of all joints to pipes.
2. Before making any joints, all jointing surfaces shall be thoroughly cleaned and dried and maintained in such condition until the joints have been completely made or assembled.
3. Notwithstanding any flexibility provided in the pipe joints, pipes must be securely positioned to prevent avoidable movement during and after the making of the joint.
4. The space between the end of the spigot and the shoulder of the socket of flexibility jointed pipes when jointed shall be as recommended by the manufacturer or ordered by the Employer's Representative .
5. After flexibly jointed pipes other than PVC pipes have been jointed, the gaps between the barrel of the pipes and the internal face of the socket shall be sealed with puddle clay, uncaulked rope yarn or other approved material.
6. Where loose collars are used to join pipes cut for closers, special tools shall be employed to keep the insides of pipes flush and collars concentric with pipes while the joint is being made.

11 FLANGED JOINTS

1. Flanges shall be correctly positioned and the component parts including any insertion ring cleaned and dried. Insertion rings shall be fitted smoothly to the flange without folds or wrinkles. Faces & bolt holes shall be brought fairly together and the joints shall be made by gradually and evenly tightening bolts in diametrically opposed positions, using only standard length spanners.

The protective coating, if any, of the flange shall be made good when the joint is completed.
2. Bolt threads shall be wrapped with PTFE tape in accordance with the relevant clause of the specification for "Materials for Roads and Sewers" before use.

12 CAST IRON JOINT FITTINGS

1. Cast Iron detachable joint collars and flanges shall be tested by striking lightly with a spanner immediately before they are placed and if they fail to ring true shall be set aside and not incorporated in the work until proven sound.

13 CEMENT MORTAR JOINTS

1. The spigots and sockets of concrete pipes shall be thoroughly moistened before cement mortar joints are made.
2. In making ogee joints to concrete pipes, a thick layer of cement mortar shall be applied to the butting faces, the pipe being laid shall be well driven against the other, & the joint finished off inside flush with pipe wall.

3. In making yarn and mortar joints for concrete and clay pipes, the spigot shall be entered into the socket of the last pipe laid until it bears on the back face of the socket and shall be centred in the socket. Two turns of tarred yarn shall then be firmly caulked into the back of the socket with a proper caulking tool. Mortar consisting of 2 parts of sand to 1 part of cement shall then be pressed firmly into the joint to fill the socket completely and shall nearly be bevelled off at 45 degrees from the outside edge of the socket.
4. Joints made with cement mortar shall remain exposed for at least three hours to allow for the initial set of the cement. All joints shall be examined and approved before the refilling of the trench is commenced.

14 PROTECTION OF PIPES AND JOINTS

1. Where directed in the Contract, cast iron joints shall be protected against corrosion by one of the methods stated below, after all parts of each joint have been thoroughly cleaned:
 - (i) The joint shall be primed and coated with paste, filled and moulded with mastic to smooth out the contours of bolts and joints, and thereafter wrapped with coated tape of approved width, wound spirally with a half-width overlap. The tape shall extend a distance of 150mm along the barrel of the pipe on each side of the joint.
 - (ii) The joint shall be sheathed in a loose clear plastic sleeve of sufficient length to permit the ends to be securely sealed by tape to the barrel of each pipe. The sleeve and tape shall be of approved manufacturer and shall be applied in accordance with the manufacturer's instructions.

15 LAYING TO CURVES

1. Where flexibly jointed rigid pipes are to be laid to curves, the outside of spigots in the joints shall not butt hard against the inside of the socket. At least one-quarter of the total movement in the joint shall be left in any direction.

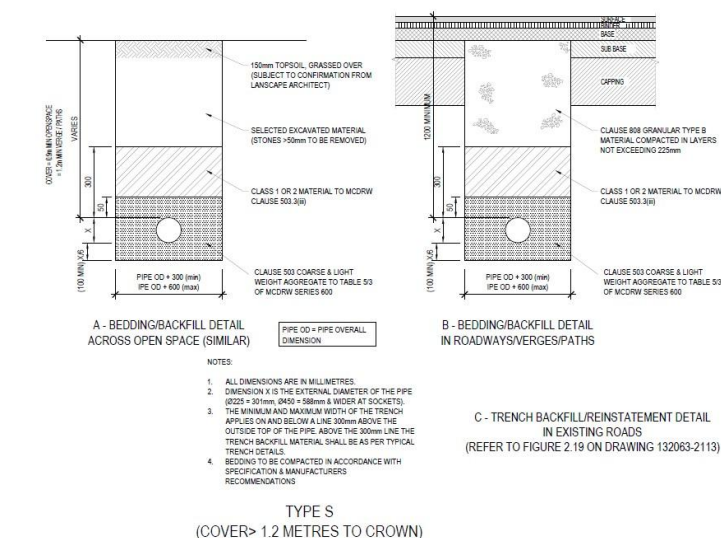
16 CUTTING PIPES

1. Iron pipes shall be cut by a method which provides a clean square cut of the pipe and of the lining, if any, without damage to pipe or lining. All cut or trimmed ends, and the parts of any pipe on which the coating may have suffered damage shall be recoated with bitumen before the pipes are laid. The external area at cut spigot ends of ductile iron pipes shall be ground for a distance of at least 125mm.
2. Concrete pipes shall be cut to a square and even finish without splitting or fracturing the wall of the pipe. Reinforcement shall be cut back flush with the concrete and bare metal protected with bituminous paint or cement grout as directed.

17 BACKFILLING OF TRENCHES

1. If the Contractor allows material to become unsuitable which, when excavated was suitable for re-use, and it is unsuitable when required for backfilling, he shall make good by running it to spoil and replacing with suitable materials at his own expense.

2. Where required to meet the specification for testing pipelines, trenches shall be partially backfilled to provide anchorage, but joints shall be left exposed.
3. Backfilling shall wherever practicable be undertaken as soon as the specified operations proceeding it have been completed. In the case of rigid pipes with concrete haunch or surround, after 24 hours a 300mm layer of backfill may be placed over the pipe, but no more backfilling may be placed until the concrete has reached a strength of 8N/mm².
4. No backfill material shall be placed in trenches containing water.
5. In trenches in roads, footpaths, private access paths and where directed in the Contract, above 300mm over the crown of the pipe backfill material shall be class B granular material to clause 33 of the specification for "Materials for Roads and Sewers" deposited in layers not exceeding 225mm and compacted in accordance with Clause 802 of the NRA Specification for Roadworks up to formation level
6. In trenches, in fields, open country or private gardens backfill material above 300mm over the crown of the pipe may be selected material compacted using the method compaction approach to clause 612 of the NRA Specification for Roadworks. It may be placed by machine, provided the method of operation ensures that the material slides or rolls into position and does not drop from a height.
7. Sufficient space shall be left to receive the original thickness of soil, turf or other materials removed from the surface. The surfaces shall be restored by replacing the materials in their proper order and form, and by compacting them to such level as will ensure that after settlement is complete the surface level of refilled trenches shall be within 30mm of that of the adjacent undisturbed ground.



Typical Trench Backfilling Detail

18 DITCHES

1. Ditches crossing under road

Where an existing ditch crosses a road and cannot be intercepted and drained into a surface water sewer, the ditch shall be excavated to a firm bottom at least 400 mm wide. A 225mm thick bed of 50 - 75mm stone shall be laid to a uniform grade, and

- (i) A 225mm diameter ogee concrete pipe or a size directed in the Contract shall be laid open jointed on this bed and surrounded by a layer of 50-75mm stone to 300mm over the soffit of the pipe.
- (ii) The remainder of the ditch shall be backfilled in accordance with Clause 17.5 of this specification.
- (iii) The drain shall be connected to the nearest surface water sewer.

2. Clearing Existing Ditches

Existing ditches shall, where shown in the Contract, be cleared by removing vegetable growths and deposits. The sides shall be trimmed throughout and the bottoms uniformly graded and the ditches kept clean and maintained for the period of execution of the works. Material removed from existing ditches shall be disposed of in tips outside the site provided by the Contractor.

3. Clearing and piping existing ditches

Existing ditches where shown in the Contract to be cleared and piped shall be excavated and piped in accordance with Clauses 18.1 and 18.2 of this specification. The remainder of the ditch shall be backfilled in accordance with Clause 17.6 of this specification.

19 LAND DRAINS

1. Where land drains are cut by road or trench excavation, they shall be connected to the adjacent surface water system.

20 CONNECTION TO SEWERS

1. Where shown in the Contract, connections to foul and surface water sewers of the diameter indicated, and road gulley connections shall be made as shown on contract drawings.
2. Splay junction or saddles shall be used to connect to existing sewers.
3. Concrete haunching or surround to be dependent on depth of connections under road formation as shown on detail drawings.
4. Stoppers or seals shall be fitted to the open end of all buildings connections.
5. 2 metre stakes, properly marked, shall be driven into the ground at the stoppered end of the connection, and the concrete channel of the carriageway shall be marked "F.C". Every care shall be taken to prevent the stakes being disturbed and the Contractor shall take the responsibility for their safety.
6. The Contractor shall record the invert level and diameter of all connections as well as the position of the connection giving distance from nearest manhole.

21 SETTING VALVES etc

1. Care shall be taken to prevent damage to all valves, fire hydrants and the like, and their ancillary equipment. Valves etc. and ancillary apparatus shall be stored in clean condition and in a manner that excludes all water. When directed, headstocks, motors, gearing or indicators shall be removed, adequately labelled for identification, stored carefully in weatherproof premises and be reconnected after erection of the valves. Frost cocks shall be kept clean and free from obstruction. Electrical equipment shall be protected from damp and damp-proofing seals shall remain intact until the electrician is ready to connect up the equipment.
2. The gunmetal faces and seats of all valves shall be kept clean. No valve shall be closed without first wiping the faces with a clean cloth. The cavity beneath the valve door shall be thoroughly cleaned by hand. In the event of accident, fouling matter shall be either dissolved or carefully removed by methods that do not involve scraping of the gunmetal faces.
3. Where valves are supplied fitted with mud doors and starting bolts in the bottom of the body, the starting bolt shall be left out, when the door is shut for the first time on the site. When the door has been set down on the seat the starting bolt shall be run up to make contact with the door and shall then be turned back to clear the door. In no case shall a starting bolt be inserted without ensuring that the door on closing shall clear the starting bolt.
4. All valves shall be set so that operating spindles are truly vertical unless otherwise shown in the Contract or directed.
5. Before each valve is put into service all gears, bearings and spindles shall be oiled with an approved oil as recommended by the valve maker. Oil baths shall be topped up to the appropriate levels and all grease nipples charged with grease of approved manufacture. No deleterious matter shall be allowed to come into contact with the working faces and oil sumps shall be maintained clean.
6. Every stuffing box shall be examined when the main is charged with water and leaking boxes shall be adjusted or repacked with square plaited lubricated hemp packing of approved manufacture. The stuffing box shall not be so tightly packed as to materially affect the friction of the packing on the spindle.
7. No air valve shall be stored before erection in the open in the sunlight, or upside down to expose the balls and air cavities. Air valves shall be checked before the main is charged to ensure that the balls and faces are not scored or split and that there is no dirt or other deleterious material in the cavities of the body. All air nozzles should be probed to see That they are clean.
8. Fire hydrants, frost plugs and similar fittings shall be checked before being incorporated in the line and before the main is charged to ensure that all passageways are clean.
9. The installation of special types of valve and metering equipment shall be strictly in accordance with the manufacturer's instructions.

22 CLEANING PIPELINES ETC

1. Immediately before being handed over to the Client every non-pressure pipeline shall be thoroughly cleaned and pipes not exceeding 400mm diameter shall be flushed with clean water while being rodded from manhole to manhole with a rubber tipped plunger the same size as the bore of the pipe. Manholes shall be left clean and free of all debris.

2. The bore, linearity & jointing of all drains & service ducts less than 300mm shall be checked by drawing through each completed length of pipe a mandrel 750mm long & 12mm less in diameter than the nominal bore of the pipe, unless an alternative method of checking is approved.

23 TESTING OF SEWERS AND DRAINS

1. All sewers and drains shall be subject to the Water Test described in "Recommendations for Site Development Works for Housing Areas" published by An Foras Forbartha and manholes shall be subject to the infiltration test described in the same document.
2. In the case of the foul sewers and drains the water test involves testing under a head of not less than 1m of water at the high point and not more than 2.5m of water at the low point of the line under test for a period of 30 minutes, the maximum allowable loss of water being specified in the above document. Surface water sewers and drains shall be similarly tested with the exception that the head of water shall be not more than 2m over the crown of the pipe at the low point of the line under test.

24 INSPECTION AND TESTING OF WATER MAINS (EXCLUDING THERMOPLASTIC PRESSURE PIPELINES)

I. General

All pipes, fittings and appliances before delivery to the site, should be inspected to see whether they bear, where appropriate, the proper British Standard mark and where required, the mark of the Water Undertaking's Testing Station.

2. Mains

All pipes and fittings should be inspected and tested by the manufacturers at their factory, and should comply with the requirements of the specification.

The pipes and fittings should be inspected on site before laying and any defective items should be clearly marked as rejected and forthwith removed from the site.

After laying, jointing and anchoring, the main should be slowly and carefully charged with water, so that all air is expelled, allowed to stand full for several days and then tested under pressure.

A long main should be tested in sections as the work of laying proceeds, and it is an advantage to leave the joints exposed for inspection during the testing.

The open end of the main may be temporarily closed for testing under moderate pressure by fitting a watertight expanding plug, of which several types are available. The end of the main and the plug should be secured by struts or otherwise to resist the end thrust of the water pressure in the main.

If the section of main tested terminates with a sluice valve, the wedge of the valve should not be used to retain the water; instead the valve should be fitted temporarily with a blank flange, or, if a socketed valve, with a plug, and the wedge should be placed in the open position while testing. End support should be given as in the preceding Subclause.

The test pressure should be applied by means of a manually-operated test pump or, in the case of long mains or mains of large diameter, by a power-driven test pump which should not be left unattended. In either

case, precautions should be taken to ensure that the required pressure is not exceeded. Pressure gauges should preferably be recalibrated before the test.

The test pressure shall be the maximum working pressure plus 50 per cent, but for cast-iron and spun-iron pipes, the test pressure should not exceed that due to 400, 600 or 800 ft. head for Class B, C or D pipes respectively. The pipeline should be adequately restrained and anchored during the test.

The test pressure should be maintained by the pump for one hour and if there is any leakage it should be measured by the quantity of water pumped into the main in that time. A general leakage rate of 0.11 litres per millimetre of nominal pipe diameter, per kilometre length, per 24 hours may be considered reasonable, but any visible leak should be repaired.

This method is detailed in the "Recommendations for Site Development Works for Housing Areas" published by An Foras Forbartha

25 TESTING OF THERMOPLASTIC PRESSURE PIPELINES

1. Testing of Thermoplastic Pressure Pipelines

The Clauses for Testing of Pressure Pipelines (excluding Thermoplastic Pressure Pipes) shall apply, except that testing shall be carried out in accordance with the procedures in "A guide to testing of water supply pipelines and sewer rising mains" published by WRc.

26 SURFACE WATER ATTENUATION STORAGE & INFILTRATION SYSTEM

1. Chambers shall be Stormtech SC-740 or approved equal parabolic arch with cantilever foot. Chamber rows shall provide continuous, unobstructed internal space with no internal support systems. Chambers to be made of virgin polymer, injection moulded polypropylene with independent verification on 1) long duration dead loads and 2) short duration live loads based on the BD31-01 / BS EN 9295 design truck with consideration for impact and multiple vehicle presences. Creep modulus data (including 10,000hr test data) for product to be submitted as part of technical submission to verify long term performance as per BS8006. Chambers shall be produced at an ISO 9001 certified manufacturing facility.

27 RAIN WATER HARVESTING GRP STORAGE TANK

1. Tank shall be a Class 1 GRP material and fitted with overflow siphon, calmed inlet and vermin guard.
2. 100mm services duct to be provided from GRP tank turret to plant room for cables, power supply.
3. 100mm services duct to be provided from GRP tank turret to plant room for service connection.

28 RAIN WATER LEAF FILTER

1. Leaf filter according to DIN 1989-2, Typ C and installed in a concrete manhole (Ø 1200 mm) for access. Relative connection capacity according to DIN 1986 for roof areas up to 3000 m². Max. Flow Rate Sieve insert 9l/sec = 32.4 m³ cleaned water per hour. Inlet rainwater 2 x DN 250. Outlet to storage DN 200. Outlet into sewer DN 250 Height difference between inlet and outlet 320 mm. Material Filter corpus: stainless steel

4016. Material Filter sieve: stainless steel 1.4301. Mesh size: 0,4 x 1 mm. Legs = Thread rods M10 with screw nut made of stainless steel, Length 250 mm.

29. RAIN WATER NON-RETURN VALVE

1. PART 1: GENERAL

1.01 SUBMITTALS

A. Non return valve shall have product literature submitted that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, elastomer characteristics, headloss, flow data and pressure ratings.

B. Upon request, provide shop drawings that clearly identify the valve materials of construction and dimensions.

1.02 QUALITY ASSURANCE

A. Supplier shall have at least twelve (12) years experience in the design and manufacture of "CheckMate®" style elastomeric check valves.

B. Manufacturer shall have conducted independent hydraulic testing to determine headloss, jet velocity and vertical opening height characteristics on multiple sizes of CheckMate® valves ranging from 4" through 72". The testing must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.

2. PART 2: PRODUCTS

2.01 "CHECKMATE®" ELASTOMERIC CHECK VALVES

A. Check Valves are to be all rubber and the flow operated check type with slip-in cuff or flange connection. The entire CheckMate® Valve shall be ply reinforced throughout the body, disc and bill, which is cured and vulcanized into a one-piece unibody construction. A separate valve body or pipe used as the housing is not acceptable. The valve shall be manufactured with no metal, mechanical hinges or fasteners, which would be used to secure the disc or bill to the valve housing. The port area of the disc shall contour down, which shall allow passage of flow in one direction while preventing reverse flow. The entire valve shall fit within the pipe I.D. Once installed, the CheckMate® Valve shall not protrude beyond the face of the structure or end of the pipe.

B. The downstream end of the valve must be circumferentially in contact with the pipe while in the closed positions.

C. Slip-in style CheckMate® Valves will be furnished with a set of stainless steel expansion clamps. The clamps, which will secure the valve in place, shall be installed inside the cuff portion of the valve, based on installation orientation, and shall expand outwards by means of a turnbuckle. Each clamp shall be predrilled allowing for the valve to be pinned and secured into position in accordance with the manufacturer's installation instructions. Flange style CheckMate® Valves will be furnished with a stainless steel, ANSI 125/150 drilled, retaining ring unless specified otherwise.

D. Manufacturer must have flow test data from an accredited hydraulics laboratory to confirm pressure drop and hydraulic data. Company name, plant location, valve size patent number, and serial number shall be bonded to the check valve.

2.02 FUNCTION

A. When line pressure exceeds the backpressure, the line pressure forces the bill and disc of the valve open, allowing flow to pass. When the backpressure exceeds the line pressure, the bill and disc of the valve is forced closed, preventing backflow.

2.03 MANUFACTURER

A. All valves shall be of the slip-in or flanged CheckMate® as manufactured by Tideflex Technologies®, A Division of Red Valve Company, Carnegie, PA 15106. All valves shall be manufactured in the U.S.A.

PART 3: EXECUTION

3.01 INSTALLATION

A. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

3.02 MANUFACTURER'S CUSTOMER SERVICE

A. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

B. If specified, the manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

30 VORTEX FLOW CONTROL

1. Unit to be fitted with a remotely controlled emergency pivoting by-pass door, designed to be wet mounted.
2. Vortex flow control shall be manufactured in grade 304 stainless steel to BS 1449 minimum 3 mm. thick (or greater depending upon hydraulic head). Incorporate a pivoting by-pass door on the front face of the flow control to allow direct access to the downstream pipe, operated from ground level by means of a stainless steel rope. The design criteria for the unit shall match that specified by the engineer and that shown on the head / discharge curve supplied by the manufacturer. The 'flush flow' and 'kickback flow' shall match that specified by the engineer as well as that shown on the head / discharge curve supplied by the manufacturer..

31 PENSTOCKS & ACTUATORS

1. MATERIAL SPECIFICATION

Seals - Frame seals to be of resilient, low friction materials selected for its resistance to ultra violet degradation.

Frames - Frames to be manufactured from stainless steel to BS EN 10088:1995 grades 1.4301 (304) or 1.4401 (316).

Doors - Doors to be manufactured from stainless steel to BS EN 10088:1995 grades 1.4301 (304) or 1.4401 (316).

Flush Invert - Flush invert seal arrangement to allow for a smooth transmission of flow through the penstock.

Spindle - The spindle to be manufactured in stainless steel.

Frame Yoke - For wall mounted penstocks frame yokes to be fitted when the thrust needs to be taken by the frame.

The yoke is gusseted and bolted to the frame to allow for removal. The yoke material is the same as for the frame.

For channel mounted penstocks the yoke to be an integral part of the frame.

Pressure Pads - Pressure pads to be fitted to penstocks which are wall mounted type only and subjected both on/off

seating pressures.

Fixing Bolts - Bolts to be provided for wall mounted units.

Door Nut - Manufactured from phosphor bronze to BS EN 12167:1998 for non-rising stem applications, or cast iron

to BS EN 1561 min. 250 for rising stem types.

Operating Gear - Actuator

6 MANHOLES, VALVE, HYDRANT CHAMBERS AND COVERS

SPECIFICATION FOR MANHOLES, VALVE, HYDRANT CHAMBERS AND COVERS

CONTENTS:

PREAMBLE

- 01 Manholes - Type of Construction
- 02 Manholes - In-Situ Concrete
- 03 Manholes - General
- 04 Valves & Hydrants - Chambers & Covers
- 05 Details

PREAMBLE:

This specification contains two pages.

Where the contract to which this specification is being applied is of any form other than the RIAI Standard Form of Contract, then all references herein to 'the Employer's Representative ' shall be deemed to be replaced by an equivalent reference to 'DBFL Consulting Engineers'.

References herein to Irish, British or other National Standards of Practice do not give the year of issue or dates of amendment. The latest relevant published version including any relevant amendments at date of invitation to tender shall apply.

Where a Standard or Code of Practice has been superseded the latest edition of the superseding publication shall apply.

References herein to other specifications shall be to DBFL specifications unless noted otherwise.

Where the preambles to the Bills of Quantities and the Standards and Codes of Practice referred to herein are at variance, the more onerous requirement shall take precedence.

Requirements of the Building Regulations shall take precedence over any requirement referred to herein .

01 MANHOLES - TYPE OF CONSTRUCTION

- 1. Standard Details of Manholes are shown on relevant site-works details drawings. They relate directly to the Greater Dublin Regional Code of Practice for Drainage Works as amended by the requirements of Dublin City Council.
- 2. All manholes shall be watertight and shall be constructed on a concrete foundation slab as specified in the specification for "Concrete Work". Joints shall be treated as Clauses No.3 and 4 of this specification below.
- 3. Where concreting is to be carried out in more than one pour, the surface film of the concrete placed earlier shall be removed whilst the concrete is still green to expose the aggregate and leave a sound irregular surface.

4. Just before concreting is resumed, the roughened joint surface shall be thoroughly cleaned and freed from loose mortar, preferably without re-wetting, and then treated with a thin layer worked well into the surface of cement grout or of cement : sand mortar in which the ratios of sand to cement and water to cement do not exceed those in the next concrete. The Contractor shall take precautions to avoid segregation of the concrete along the joint plane and to obtain thorough compaction.

02 MANHOLES - IN-SITU CONCRETE

1. In-situ concrete manholes shall be of the appropriate mix specified in the specification for "Concrete Work" and shall be fair faced internally, free from honeycombing and to a high standard of surface finish. Concrete shall be vibrated.
2. Thickness of walls, size of manhole shafts, and rungs shall be as shown on the detail drawings.

03 MANHOLES - GENERAL

1. Pipes in and out of manholes shall be as short as practicable and the pipe joints external to the manhole shall not be further than 600mm from the inner face of the manhole wall. Pipe ends shall be built in monolithically with the manhole and the manhole made watertight. The pipe ends projecting beyond the manhole walls shall be surrounded in concrete as specified in the specification for "Concrete Work", 150mm thick mass concrete. Where line, level and pipe diameter permits, the pipeline may be laid unbroken through the manhole position subject to the pipe joints external to the manhole being not further than 600mm from the inner face of the manhole wall.
2. The depth of the main channel shall not be less than the diameter of the largest pipe, Main channel inverts for pipes up to and including 300mm diameter shall be vitrified clay, asbestos cement or precast concrete channels. Main channel inverts for pipes over 300mm diameter may be as the foregoing or may be formed in mass concrete as specified in the specification for "Concrete Work, rubbed up and finished in 2 to 1 cement mortar with steel float finish. Where pipes have been laid unbroken through the manhole position the crown of the pipe shall be broken out to the half diameter over the full length of the manhole and the benching completed as shown on the detail drawings.
3. Branch bends over 150mm diameter shall be curved in the direction of flow and set to deliver over the main channel invert and shall be formed in mass concrete as specified in the specification for 'Concrete Work'. Spaces between branch bends shall be completely filled with concrete and the faces above the main and branch channel inverts shall be trowelled smooth.
4. Bases and benching shall be formed in mass concrete and benching finished as in Clause 03.2 of this specification with slope towards the main channel of 3%.
5. Manhole covers and frames shall be fixed in the position shown, the frames shall be solidly bedded in cement mortar so that the covers when in position are fair and even with the adjacent surfaces. Where shown or directed, frames shall be bedded on from one to three courses of brickwork in cement mortar.
6. A manhole shaft (excluding the 1-3 courses of brickwork under the cast iron cover) shall not be constructed unless the completed depth will exceed 1.0 metre.

7. Cover slabs shall be reinforced as shown on the detail drawings, minimum cover to steel 30mm and concrete shall be mass concrete as specified in the specification for 'Concrete Works'. Precast concrete beams and/or slabs may be used if approved by the Employer's Representative .
8. In connecting new sewer pipelines to existing manholes, the Contractor shall make neat openings in manhole walls, carefully build in new pipes etc. and finish the work in accordance with the above specification for new work.

04 VALVES AND HYDRANTS - CHAMBERS AND COVERS

1. Chambers for hydrants on water-mains shall be a precast concrete box of dimensions shown on the site-works drawings. The box cover and frame shall be set in accordance with that drawing and Clause 03.5 of this specification.
2. Valve protection, covers and frames shall be set in accordance with the site-works drawings and Clause 03.5 of this specification.

05 DETAILS

This specification should be read in conjunction with site-works drawings.

7 CONCRETE WORK

SPECIFICATION FOR CONCRETE WORK

CONTENTS:

PREAMBLE

- 01 General
- 02 Sequence of Construction
- 03 Cement
- 04 Aggregates
- 05 Water
- 06 Admixtures
- 07 Mixing
- 08 Concrete Mixes
- 09 Ready-Mixed Concrete
- 10 Testing of Concrete
- 11 Action to be taken in the event of Failure of Test Cubes
- 12 Concrete Binding
- 13 Jointing New Concrete
- 14 Construction Joints
- 15 Frost
- 16 Curing
- 17 Traffic over Concrete
- 18 Formwork Generally
- 19 Falsework and Formwork
- 20 Removal of Formwork
- 21 Mould Oil and Grease
- 22 Holes and Chases in Concrete
- 23 Quality of Finish
- 24 Classification of Finishes
- 25 Finish to tops of Slabs
- 26 Test Samples of Type E Finish
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- 29 Cutting and Bending
- 30 Waterproof Concrete Construction
- 31 Watertightness Testing
- 32 Services through Walls and Floors of Waterproof Structures
- 33 Inspection of Concrete Work
- 34 Tolerances for Finished Work
- 35 Form A – Schedule for the Specification Requirements of Designed Mixes

PREAMBLE:

This specification contains 14 pages.

Where the contract to which this specification is being applied is of any form other than the RIAI Standard Form of Contract, then all references herein to 'the Architect' shall be deemed to be replaced by an equivalent reference to 'DBFL Consulting Engineers'.

References herein to Irish Standards, IS European Standards or British Standards do not give the year of issue or dates of amendment. The latest relevant published version including any relevant amendments at date of invitation to tender shall apply.

Where a Standard has been superseded the latest edition of the superseding publication shall apply.

References herein to other specifications shall be to DBFL specifications unless noted otherwise.

Where the preambles to the Bills of Quantities and the Standards referred to herein are at variance, the more onerous requirement shall take precedence.

Requirements of the Building Regulations shall take precedence over any requirement referred to herein.

01 General

1. All concrete work shall be carried out in accordance with IS EN 197, IS 5, IS 326, IS EN 206, IS EN 12620, IS EN 1008, IS EN 13055, IS EN 480, IS EN 934, BS 8110 and BCA Publication No. 97.328 National Structural Concrete Specification for Building Construction. It shall be assumed that the Concrete Contractor is familiar with this publication.
2. The materials, labour and workmanship in and connected with the execution of the concrete work shall be the best of their kind without regard to any trade terms. The Contractor shall employ a duly qualified person experienced in reinforced concrete construction to supervise the work. The quality of materials and the standard of workmanship for the reinforced concrete shall comply with the relevant Clauses of BS8110 with regard to all requirements not otherwise described in this specification.

The Architect shall be afforded all reasonable opportunity and facility to inspect the materials and the manufacture of concrete and to take samples or to make any test.
3. The term "formwork" shall be deemed to include falsework.
4. Do not scale the drawings. Use dimensions figured on the drawings for setting out the works.

02 Sequence of Construction

1. The sequence of concrete construction shall be subject to the approval of the Architect. It shall be arranged in such a way as to minimise the effects of differential shrinkage, deflection, settlement and thermal effect. The Contractor shall therefore arrange his concreting programme as far as possible in such a way that the structural elements and foundations are uniformly loaded and the load is uniformly increased. Particular attention shall be given to junctions of blocks and expansion joints.

03 Cement

1. The cement shall be ordinary Portland Cement, or other cement approved by the Architect, complying in all respects with IS EN 197. The Contractor shall provide details of proposed cements for approval and shall not under any circumstances use unapproved cements. Manufacturer's test certificates shall be provided by the Contractor as required.
2. Cement delivered in standard bags shall be properly stored in a weatherproof shed with the floor raised above ground level and having a clear space of at least 225mm between the underside of the floor beams and the ground surface. Cement delivered in bulk in a tanker shall be properly stored in a silo of IS or BS approved design. Each consignment shall be kept separate, identified and used in order of delivery.
3. Cement damaged in storage or handling shall not be used in the manufacture of white concrete.

04 Aggregates

1. The aggregates for concrete shall consist of naturally occurring material complying in all respects with IS EN 12620 and IS 5 (Note: the use of 'all-in' aggregates shall not be permitted).
2. All aggregates shall be free from laminated, and/or flaky particles, dust, silt, clay and other impurities.
3. The fine aggregates shall be washed natural pit or river sand, passing a 6mm sieve and shall be graded from the largest to the smallest particles sizes to the Architect's satisfaction.
4. The coarse aggregate shall be retained on a 6mm sieve and shall be composed of clean washed gravel or clean crushed hard stone. It shall be delivered to site in two sizes up to 19mm when maximum aggregate size of 19mm is used, and three sizes up to 38mm when a maximum aggregate size of 38mm is used.
5. The use of marine aggregates shall be excluded.
6. The chloride content of the aggregate shall be such that the total chloride content of the concrete mix shall not exceed 0.35% expressed as a percentage of chloride ion by weight of cement.
7. The aggregates used for prestressed concrete shall be free from chloride.
8. Aggregates shall be chosen such that the drying shrinkage of the concrete is minimised and conforms to the requirements of IS EN 1367.
9. Special attention shall be given to the selection of aggregates to all exposed and waterproof concrete.

10. Before concreting operations are begun, samples of the aggregate shall be submitted to a laboratory, chosen by the Architect, for testing and approval. The weight of samples shall not be less than 15Kg for each size of coarse aggregate and 5Kg for the fine aggregate.
11. The quality of all aggregates delivered to the site shall be equal or superior to that of the approved samples.
12. Separate storage facilities with adequate provision for drainage shall be provided for each different size of aggregate used.

05 Water

1. Water shall be clean and free from harmful matter and shall be of potable quality.
2. If water is not supplied from local authority mains, then the Contractor shall arrange for tests to be carried out in accordance with BS3148 and shall bear the cost of these tests.

06 Admixtures

1. Admixtures other than those herein specified shall not be used without the approval in writing of the Architect. Under no circumstances shall calcium chloride be used as an additive in the concrete mix.
2. Air entraining admixtures, if permitted, shall be based on vinsol resin and comply with IS EN 480, IS EN 934.

07 Mixing

1. The quantity of cement, the quantity of fine aggregates and the quantities of the various sizes of coarse aggregate shall be measured by weight only. A separate weighing device shall be provided for weighing the cement.
2. The amount of water shall be measured by volume or weight. Any solid admixture to be added shall be measured by weight only, but liquid or paste admixtures shall be measured by volume or weight.
3. The batch weight of aggregates shall be adjusted for the moisture content of the aggregate being used. The quantity of water contained in the aggregates shall be determined by the Contractor in accordance with a method approved by the Architect, and the quantity of water to be added to the mix shall be reduced by the quantity of water contained in the aggregates being used.
4. The accuracy of all measuring equipment shall be within 3% of the quantity of cement, water or total aggregates being measured and within 5% of the quantity of any admixture being used. All measuring equipment shall be maintained by the Contractor in a clean, serviceable condition.
5. The mixer shall comply with the requirements of BS1305. The mixing time shall not be less than two minutes or the time necessary to ensure compliance with the required strength. When the mixer is a lorry mounted mixer no water shall be added at the batching plant or in transit to site.

08 Concrete Mixes

1. The responsibility for producing concrete to the required strength is entirely that of the Contractor/Producer.

2. Concrete Mixes and required strengths for different elements shall be as specified:
 - (i) On the Structural Engineers drawings and/or
 - (ii) In Form A – Schedule for the Specification Requirements of Designed Mixes, at the back of this Specification and/or
 - (v) In the absence of (i), or (ii) above, in Table 1 below.

TABLE 1. CONCRETE GRADES/MIXES TO BE USED IN THE ABSENCE OF OTHER INSTRUCTIONS - BASED ON MAX 20MM AGGREGATE			
Type/Use of Concrete	Grade	Minimum Cement Content	Nominal Slump
Blinding not greater than 75mm thick	C8/10	200 kg/m ³	S3
Unreinforced Screed, Inside Buildings	C20/25	240 kg/m ³	S3
Reinforced Screed, Inside Buildings	C25/30	275 kg/m ³	S3
Mass Concrete, and Blinding greater than 75mm thick	C25/30	280 kg/m ³	S3
Reinforced Concrete	C30/37	300 kg/m ³	S3
Precast Concrete	C32/40	350 kg/m ³	S3
Prestressed Concrete	C40/50	400 kg/m ³	S3

3. Where specified 'Air-Entrained Concrete' shall be produced using an approved air-entraining agent at a dosage as recommended by the manufacturer.
4. As an example of the terminology used above, Grade 28/35 is concrete with 28 N/mm² min. characteristic cylinder strength and 35 N/mm² min. characteristic cube strength.

09 Ready-mixed Concrete

1. Ready-mixed concrete may be used on the basis of a designed mix, subject to the Architect's approval to the manufacturer and supplier.

2. It shall be the Contractor's responsibility to ensure that his Concrete Producer shall fully comply with the specification and shall provide the Architect or his representative full co-operation and facilities for carrying out all inspection and testings that may be required.
3. Deliveries shall be accompanied by delivery ticket for each batch of concrete and they shall contain the following information.
 - (i) Name of the ready-mixed concrete plant.
 - (ii) Serial number of ticket.
 - (iii) Date and time of loading, i.e. time of first contact between cement and water.
 - (iv) Truck number or vehicle identification.
 - (v) Name of purchaser.
 - (vi) Name and location of site.
 - (vii) Details of reference to specifications, e.g. code number, order number
 - (viii) Amount of concrete in cubic metres.
 - (ix) Declaration of conformity with reference to the specifications and to IS EN 206-1.
 - (x) Name or mark of the certification body if relevant.
 - (xi) Time at which concrete arrives on site.
 - (xii) Time of the beginning of unloading.
 - (xiii) Time of the end of unloading.

In addition, the delivery ticket shall give details of the following:

For designed concrete –

 - (xiv) Strength class.
 - (xv) Exposure classes.
 - (xvi) Chloride content class.
 - (xvii) Consistence class or target value.
 - (xviii) Limiting values of concrete composition, if specified.
 - (xix) Type and strength class of cement, if specified.
 - (xx) Type of admixture and addition, if specified.
 - (xxi) Special properties, if required.
 - (xxii) Maximum nominal upper aggregate size.
 - (xxiii) In the case of light-weight or heavy-weight concrete: density class or target density.

10 Testing of Concrete

1. Conformity Testing of Concrete:

- (i) The Concrete Producer shall undertake Conformity Testing of all the designed concretes in accordance with IS EN 206.
- (ii) All concrete shall be subject to Production Control in accordance with IS EN 206.
- (iii) This Conformity Testing shall have independent third party accreditation by NSAI or other approved organisation.
- (iv) The Concrete Producer shall provide all Conformity Test results to the Architect for each designed concrete provided.

2 Identity Testing of Concrete:

- (i) Identity Testing shall be carried out on all designed concrete unless directed otherwise by the Architect.
- (ii) This identity Testing shall be carried out by an Independent Testing Laboratory.
- (iii) Sampling of concrete shall be in accordance with IS EN 12350.
- (iv) Shape, dimensions, making, curing and testing of concrete test cylinders and cubes shall be in accordance with IS EN 12390.
- (v) Each cylinder / cubes shall be made from a single sample of concrete.
- (vi) Rates of sampling for different elements shall be as stated in Table 2 below:

TABLE 2. RECOMMENDED MINIMUM RATES OF SAMPLING FOR IDENTITY TESTING OF CONCRETE	
Critical Elements (columns, masts, cantilevers etc)	1 sample per 2 trucks
Typical Elements (Beams, slabs etc)	1 sample per 4 trucks
Low Risk Elements (Rafts, etc)	1 sample per 10 trucks

3. Compliance with the specified compressive strength may be assumed if :
- (i) Concrete is deemed to come from a conforming population if both the criteria in Table B.1 (From Annex B of IS EN 206) are satisfied for “n” results derived from strength tests on samples taken from the defined volume of concrete.

Table B.1 – Identity Criteria for Compressive Strength (From Annex B of IS EN 206).

Number “n” of test results for compressive strength from the defined volume of concrete	Criterion 1	Criterion 2
	Mean of “n” results (f_{cm}) N/mm ²	Any individual test result (f_{ci}) N/mm ²
1	Not applicable	$\geq f_{ck} - 4$
2 – 4	$\geq f_{ck} + 1$	$\geq f_{ck} - 4$
5 – 6	$\geq f_{ck} + 2$	$\geq f_{ck} - 4$

Note: The identity criteria of table B.1 give a probability of 1% that a conforming concrete volume is rejected.

11 Action to be taken in the event of Failure of Test Cubes

1. When an individual cube fails to meet Criteria above, the cost of additional testing and/or the replacement of any portions of concrete deemed to be defective by the Architect shall be borne by the Contractor/Producer.

12 Concrete Blinding

1. The surface of the ground under foundations and other concrete in contact with the ground or with hardcore shall be sealed with a layer of concrete Grade C8/10, average 50mm thick unless specified otherwise.
2. Any concrete or blinding which is thicker than 75mm shall be mass concrete grade C20/25, unless specified otherwise.

13 Jointing New Concrete

1. Treat the surface of the existing concrete at the joint before placing new concrete as follows ...

- (i) When the concrete is between 2 and 4 hours old, wet the surface with a fine spray (not a jet) and at the same time brush the mortar from the face of the joint without disturbing the coarse aggregate.
- (ii) When the concrete is between 4 and 24 hours old and (i) has not been carried out, remove the mortar from the face of the joint with a wire brush or water jet without disturbing the coarse aggregate.
- (iii) When the concrete is between 1 and 3 days old and neither (i) nor (ii) have been carried out, remove the mortar from the face of the joint by grit blasting or with a needle gun without disturbing the coarse aggregate and wash off any dust from the surface. Do not hack or hammer the surface.

14 Construction Joints

1. All vertical construction joints shall be formed with well braced timber stop ends holed or slotted where necessary to allow the reinforcement to pass through the joints. The concrete shall be compacted against the stop end of the full height of the lift.
2. The Contractor shall if required prepare a detailed layout of the construction joints for each section of the work, including details of all waterbars, which shall be submitted to the Architect for approval before any work commences.
3. The construction sequence shall be planned so as to minimise the number of construction joints as far as is practicable while limiting the shrinkage of the concrete.
4. The vertical joints shall be stepped and staggered in approved positions and such joints shall not be located at or adjacent to quoins.
5. Except where otherwise directed, the joints in ribbed floors shall be formed in the slab parallel to the ribs. The joints in floors shall be located in such positions as will minimise the number of joints required and shall run where possible parallel with the direction of span. In beams and suspended slabs an approved splayed or halving joint shall be provided.
6. Additional reinforcement shall be provided at joints where so directed by the Architects.
7. All kickers shall be cast monolithically with the base concrete.

15 Frost

1. Concreting work shall be suspended when the air temperature falls below 2 deg. celsius or when frost is expected.
2. Frozen aggregate shall be thawed out before use by the aid of approved equipment.
3. Concrete placed in cold weather shall be protected from damage by frost or other weather conditions until such time as it has achieved sufficient strength. Any damaged or weathered concrete shall be cut out and replaced by fresh concrete at the Contractor's expense.
4. The Contract shall provide a minimum and maximum thermometer of approved design for the purpose measuring the shade temperature of the outside air.

16 Curing

1. Horizontal and vertical slabs and other large areas of concrete shall be prevented from drying out for at least 7 days after the concrete has been placed. Precautions shall be taken during the initial period of at least 7 days to protect all reinforced work from exposure to sun, wind, rain & frost. Longer periods of curing & protection may be required during periods of low temperatures.

17 Traffic over Concrete

1. No traffic or temporary load of any kind will be allowed over any concrete until the following minimum times after casting, unless approved protective methods are adopted to the Architect's satisfaction.
 - (i) Foundations, ground floor slabs and other concrete in contact with the ground: 28 days
 - (ii) Columns: 10 days
 - (iii) Suspended slabs: 10 days
 - (iv) Suspended beams: 14 days

These times are given for guidance only and do not relieve the Contractor of any responsibility for protecting the concrete work against damage from any cause whatsoever.

18 Formwork Generally

1. The design, erection and removal of formwork shall be the responsibility of the Contractor.
2. The formwork and supports and foundations shall be sufficiently rigid to resist without distortion or overstress all dead loads and incidental loads resulting from placing, vibration, etc. and they shall be designed taking into account the surface finish and tolerances required for the concrete.
3. The Contractor shall prepare full size setting-out sketches of the formwork for approval.
4. Where either architectural or engineering drawings show masonry walls or leaves abutting vertical concrete faces, suitable galvanised dovetail channels 150mm long and at 450mm vertical c/c shall be cast into the concrete by being securely incorporated into the formwork at positions corresponding to the centrelines of those masonry walls or leaves.

19 Falsework and Formwork

1. The Contractor if requested shall submit dimensioned drawings of the systems of falsework which he proposed to adopt for the various sections of the work. This falsework shall be suitably proportioned and braced to withstand the weight of the freshly placed concrete, together with the weight of the workmen and materials.
2. Where supported on the ground the sole piece carrying the vertical supports shall be bedded on a solid base and shall have an area sufficiently large to ensure that there shall be no settlement under the full load. Adjustable screws or hardwood folding wedges shall be used for adjusting and striking the vertical supports.
3. When supported on the ground floor slab a system of timber spreaders shall be used to distribute the load. Unless a screed is to be subsequently applied to the slab, special precautions shall be taken to protect the surface from any damage.

4. All shuttering shall be removed without shock or vibration. Before the shuttering is stripped the concrete shall be exposed in order to ascertain that the concrete has sufficiently hardened.
5. Shuttering to vertical surfaces may be removed whenever the concrete will not be damaged by so doing. Shuttering and supports under slabs, beams, girders, arches and structures carrying the loads, shall not be removed without the Architect's approval. The striking of the horsing shall be carried out in an approved sequence of operations so that no undue shock or other damage is caused to the permanent work.
6. The Contractor shall be responsible for any injury to work and any consequential damage caused or arising from the removal of striking of formwork, centering and supports, and any advice, permission or approval given relative to their removal shall not relieve the Contractor from the responsibility here defined.

20 Removal of Formwork

1. The Contractor shall give the Architect no less than 24 hours notice of his intention to strike any formwork.
2. The time at which formwork is struck shall be the Contractor's responsibility but the minimum periods between concreting and the removal of forms, unless otherwise approved, shall be as stated in Table 3 below. Days during which the average temperature is below 2 deg.C shall be disregarded in calculating the minimum time which shall elapse before forms are removed.

TABLE 3. MINIMUM PERIODS IN DAYS BEFORE REMOVAL OF FORMWORK		
Location	In Cold Weather 2°C - 10°C	In Normal Weather Greater than 10°C
	Days	Days
Sides of Beams Walls and Columns	2	1
Slab Soffit Forms (props left under)	10	4
Beam Soffit Forms (props left under)	14	8
Props to Slabs	21	11
Props to Beams	28	16

3. The stability of the structure and the protection of the concrete after striking the formwork shall remain the responsibility of the Contractor. Contractor to provide all necessary backpropping until the concrete has reached its design strength.

21. Mould Oil and Grease

1. All formwork shall be treated with approved mould oil or grease before use and shall be carefully cleaned down and further oiled or greased before re-use.
2. The type of mould oil or grease and its method of application to be used for shuttering for exposed surfaces shall be as recommended by the manufacturer for this kind of work and shall be subject to the Architect's approval. The use of specially faced boards of plywood shall not be permitted except with the approval of the Architect.

22. Holes and Chases in Concrete

1. Holes, chases and other openings required for the passage of pipes, conduits, etc, shall be formed by inserting suitable sleeves, cores and sinkings before placing the concrete. Before any concreting commences the Contractor shall ensure that the Sub-Contractors furnish him full information in regard to the position of such holes and chases, that their size and positions have been approved by the Architect and checked by the Sub-Contractors and that they are adequately fixed in position to ensure that they do not move during the concreting operation.
2. The position of bolts, clips, holes or other openings in the finished work shall not be permitted without the sanction of the Architect. Such holes and chases shall be made only in approved locations and shall be cut with approved tools.

23. Quality of Finish

1. The same type of formwork, formwork surface, release agent and curing compound shall be used throughout the entire area of any one specified finish. Individual plywood sheets, timber sections or small areas of formwork in large panels shall not be replaced in any location unless Type A finish has been specified. Formed surfaces of concrete not exposed in the completed works and not specified otherwise shall be free from honeycombing and excessive lipping and grout leakage.
2. The quality of finish can be identified in the following broad class terms:-

Class 2 applies to surfaces that are to be exposed to view but where appearance is not critical; such surfaces might be the walls of fire escape stairs or plant rooms and columns and beams to structures that are normally viewed in the shade, e.g. car parks and warehouse.

Class 1 is appropriate to most surfaces exposed to view including the external walls of industrial, commercial and domestic buildings;

Special Class is appropriate to the highest quality of finish of appearance, such as might be found in cathedrals or other prestigious buildings, where it is possible to justify the high cost of their production.

3. The Type of surface finish can be identified in the following terms:

Type A finish This finish is obtained by the use of properly designed formwork or moulds of timber, plywood, plastics, concrete or steel. Small blemishes caused by entrapped air or water may be expected, but the surface should be free from voids, honeycombing and other blemishes.

Type B finish This finish can only be obtained by the use of high quality concrete and formwork. The concrete should be thoroughly compacted and all surfaces should be true, with clean arises. Only very minor surface blemishes should occur, with no staining or discolouration from the release agent.

Type C finish This finish is obtained by first producing a type B finish. The surface is then improved by carefully removing all fins and other projections, thoroughly washing down, and then filing the most noticeable surface blemishes with a cement and fine aggregate paste to match the colour of the original concrete. The release agent should be carefully chosen to ensure that the concrete surface will not be stained or discoloured. After the concrete had been properly cured, the face should be rubbed down where necessary, to produce a smooth and even surface.

Loose hardwood tongues shall be used between all plywood sheets and foam sealing strips fully compressed between formwork and concrete shall be used at all construction joints.

Formwork shall be effectively watertight. Formwork ties shall be arranged in a uniform pattern as directed by the Architect and shall be provided with rubber cones against the formwork so that a neat recess about 50mm diameter x 40mm deep is at the tie after stripping. The recess shall be treated as a minor surface blemish.

The concrete surface shall be smooth, free from honeycombing lipping and grout loss, shall have true clean arises and shall be of uniform colour and texture. Only very minor surface blemishes shall be permitted.

While the concrete is still green all surface blemishes shall be filled with a fresh, specially prepared paste of cement, white cement and fine aggregate to match the colour of the concrete. After curing, the blemishes and surface where necessary shall be rubbed down with a fine carborundum stone to produce a smooth even surface.

In the case of ribbed and waffled slabs exposed to view an approved G.R.P. or polypropylene mould which shall be temporarily supported by an approved system compatible with the mould shall be used.

Joints between adjacent moulds shall be featured in the manner indicated on the Architect's drawings and the Contractor shall prepare a detailed scheme, for approval, by which this feature may be achieved.

Removal of moulds shall be achieved by the use of compressed air carried out strictly in accordance with the manufacturer's instructions.

24 Classification of Finishes

1. Type A finish shall be used below ground level where the element is covered on each side by earth or filling.
2. Type B finish shall be used for all beam, columns, walls, slabs, stairs not exposed to view. It shall also apply to both the inside and outside faces of lift pit walls and ducts.
3. Type C finish shall be used for all beams, columns, walls, slabs, stairs and other elements exposed to view.
4. Where a rendered or plastered finish is specified the concrete surfaces shall have a Type B finish and be treated to provide an adequate key. Alternatively the formwork may be coated with an approved retarding compound which shall be removed with water and wire brush as soon as possible after concreting. Precautions shall be taken to ensure that the retarding compound does not come in contact with reinforcement.

25 Finish to tops of Slabs

1. The tops of all concrete slabs shall receive a finish which shall be compatible in all respects with any subsequent topping.
2. In the case of all roof slabs, unless specifically instructed by the Architect, the full thickness of the slab including any build up to achieve falls shall be cast in a single concreting operation.
3. Where a slab is to receive a bonded screed at a subsequent stage, a tamped finish to the top surface shall be provided.
4. Where a floated finish is required the finished surface shall be free of float marks. The surface shall not be wetted nor shall additional cement be used to assist surface working.

26 Test Samples of Type C Finish

1. A test sample, of a size to be specified by the Architect, shall be prepared by the Contractor for the Architect's approval for each different element requiring a Type C finish, i.e. column, wall, beam, slab, etc. These samples shall be prepared in accordance with the specification and shall remain on site for the duration for the Contract unless otherwise directed by the Architect.

27 Reinforcement

1. Rolled mild steel bars, cold twisted bars and high tensile fabric reinforcement shall comply with the requirements of BS 4449 and BS 4483. The Contractor shall deliver, free of charge, samples of the various reinforcements for testing as directed. Any consignment or reinforcement failing to comply with the tests shall be removed from site.
2. The sizes and other dimensions of the reinforcement shall be checked against the drawings and site dimensions before the material is ordered.
3. The reinforcement shall be cut, cold bent and hooked to the dimensions shown on the drawings and schedules or to such other dimensions as may be directed.
4. No alteration of substitution shall be made in the lengths, sizes or arrangement of the reinforcement, without the prior written approval of the Architect.

5. Annealed iron tying wire not less than 1.4mm diameter shall be used.

28 Fixing Reinforcement

1. The Contractor shall provide at his own expense all spacers and stools necessary to support the reinforcement in position. These spacers shall not crush or deform and shall maintain the correct cover to the reinforcement at all times. Special spacers to support reinforcement shall be used where such are shown on the drawings and schedules.
2. The type of spacer for concrete exposed to view must be approved by the Architect before fixing commences and such approval may not be given until a test sample of cast concrete has been examined.
3. Galvanised reinforcement shall be fixed with galvanised tying wire.
4. No metal part of any device for fixing reinforcement shall remain within the concrete provided for cover to the reinforcement, unless otherwise shown on the drawings.

29 Cutting and Bending

1. Reinforcement shall be cut and bent in accordance with BS 8666, IS EN ISO 3766 and the schedule provided.
2. High yield reinforcement shall not be cold bent when the air shade temperature is below 5 C. Mild steel reinforcement shall not be cold bent when the air temperature is below 0 C.
3. Cold worked steel reinforcement shall not be heated.

30 Waterproof Concrete Construction

1. All underground service ducts, basements, and elsewhere as indicated by the Architect, shall be considered for construction purposes as if waterproof concrete construction and in these cases compliance with BS 8007 in addition to IS 326, IS EN 206, BS 8110 and this specification shall be maintained:
2. Formwork ties in these areas shall be of a type suitable for use in water retaining work.
3. All horizontal and vertical construction joints in these areas shall include an approved waterbar as shown on the drawings unless specifically indicated otherwise.

31 Watertightness Testing

1. Tests shall be carried out on all waterproof concrete elements as directed by the Architect.
2. Accessible faces of concrete elements including roofs shall show no sign of leakage when the structure is tested for watertightness and at any subsequent stage.
3. The drop in the surface level of water retained by concrete elements with inaccessible faces shall not exceed 10mm in seven days when the structure is tested for watertightness.
4. Should any element prove to be unsatisfactory when tested for watertightness or at any subsequent stage they shall be made good at the Contractor's own expense to the satisfaction of the Architect.

32 Services through Walls and Floors of Waterproof Structures

1. When it is necessary for a pipe or other duct to pass through a wall or floor these shall be cast into the panel when it is concreted unless otherwise approved by the Architect. Puddle flanges shall be provided on all such penetrations.
2. If approval to pass the pipe through the construction at a later stage has been obtained then these opes shall be boxed out and the sides of the opening shall be treated as construction joints. The pipes which are later passed through the opening shall be fitted with puddle flanges. The side of the ope shall not coincide with any construction joints.

33 Inspection of Concrete Work

1. The Contractor shall provide the Architect full facilities for the inspection of the horsing, formwork and reinforcement at all times throughout the duration of the contract.
2. 2 days notice shall be given to the Architect so that each element can be inspected to the satisfaction of the Architect.
3. No Concreting shall commence until formwork and reinforcement have been approved by the Architect.
4. Any additional work to be done to the horsing, formwork and reinforcement to satisfy the Architect shall be carried out at the Contractor's expense. No claims for delay or disruption due to such additional work shall be entertained.

34 Tolerances for Finished Work

Where more than one tolerance may be applied, the more stringent tolerance shall be adhered to.

1. Pad Foundations, Strip Footings : the permissible deviation for concrete foundations shall be -

Plan Dimensions	$\pm 75\text{mm}, -25\text{mm}$
Vertical Dimensions	$\pm 15\text{mm}$
2. Elements below ground level : The permissible dimensional deviations for structural concrete elements below ground level shall be as follows:-
 - (i) Level - For any nominally horizontal surface when measured from the nearest reference level $\pm 10\text{mm}$.
 - (ii) Position on Plan - For the position of any nominally vertical surface at the lower edge when measured from the nearest reference line $\pm 5\text{mm}$.
 - (iii) Plumb - The permissible deviation from plumb of the upper and lower edges of any nominally vertical length of the surface whichever is the smaller.
 - (iv) Cross-Section of Elements - The permissible deviation of cross-sectional dimensions of elements from those shown on the drawings shall be $\pm 5\text{mm}$.

-
- (v) Deviations at Junctions - the permissible deviation for abrupt changes in a nominally continuous surface at the junction of two concrete elements shall be $\pm 5\text{mm}$. The permissible deviation from the specified relationship of any two surfaces at a junction shall be $\pm 5\text{mm}$.
- (vi) Bow, Bulging and Local Irregularities - The Permissible amount for bow, bulging and local irregularities in the surface of elements shall be 10mm measured from a 4m straight edge or 1 in 400 of the length of the element whichever is the smaller.
3. Elements above ground level : The permissible deviation for structural concrete elements above ground level shall be as follows:-
- (i) Level - For any nominally horizontal surface when measured from the nearest reference level $\pm 3\text{mm}$.
- In the particular case of floor slabs the deviation measured from a 3 metre straight edge shall not exceed this tolerance of 3mm.
- (ii) Position on Plan - For the position of any nominally vertical surface at the lower edge when measured from the nearest reference line $\pm 3\text{mm}$.
- (iii) Plumb - The permissible deviation from plumb of the upper and lower edges of any nominally vertical surface shall be $\pm 10\text{mm}$ or 1 in 400 of the vertical length of the surface whichever is the smaller.
- (iv) Cross-Section of Elements - The permissible deviation of cross-sectional dimensions of elements from those shown on the drawings shall be $\pm 3\text{mm}$.
- (v) Deviations at Junctions - The permissible deviation for abrupt changes in a nominally continuous surface at the junction of two concrete elements shall be $\pm 3\text{mm}$.
- The permissible deviation from the specified relationship of any two surfaces at a junction shall be $\pm 5\text{mm}$.
- (vi) Bow, Bulging and Local Irregularities - The permissible deviation for bow, bulging and local irregularities in the surface of elements shall be $\pm 8\text{mm}$ measured from a 4m straight edge of 1 in 500 of the length of the element whichever is the smaller.

35 Form A – Schedule for the specification requirements for designed mixes

These mixes below shall be supplied as designed mixes in accordance with the relevant clauses of EN 206-1				
1. Mix reference				
2. Strength Class				
3. Nominal maximum size of aggregate, 10 mm (D)				
4. Types of aggregate	Coarse	IS EN 12620		
	Other (specify requirements)			
	Fine	IS EN 12620		
	Other (specify requirements)			
5. Cement type(s) complying with : (delete as appropriate) (Select from Tables NA. 2 and NA. 3. For key abbreviations see Table ND. 1)	CEM I N CEM I R SRPC CEM II/A-L (or A-LL) CEM II/A-V CEM II/A-S CEM II/B-S CEM II / A-M (S-L) CEM II / A-M (S-V) CEM II / A-M (V-L) CEM II / B-M (S-L) CEM II / B-M (S-V) CEM II / B-M (V-L) CEM III/A CEM III/B			
6. Additions complying with : delete as appropriate (Select from list in subclause NA 2.7. For key to abbreviations See Table ND. 2)	PFA GGBS			
7. Sulfate class, if applicable (delete as appropriate)	XA 1 / 200 – 600 SO ₄ ²⁻ XA 2 / 600 – 1400 SO ₄ ²⁻ XA 2 / 1400 – 3000 SO ₄ ²⁻ XA 3 / 3000 – 6000 SO ₄ ²⁻			

8. Exposure Class (as in EN 206-1) (or combinations)	X0 XC1, XC2, XC3, XC4 XS1, XS2, XS3 XD1, XD2, XD3 XF1, XF2, XF3, XF4 XA1, XA2, XA3			
9. Chloride Class	Cl 1,0 Cl 0,40 Cl 0,20 Cl 0,10			
10. Minimum cement content kg/m ³				
11. Maximum free water / cement ratio				
12. Quality assurance requirements				
13. Rate of sampling intended by the purchaser for strength testing (for information)				
14. Other requirements (alkali, etc. as appropriate)				
In the case of fresh concrete the following shall be completed by the purchaser				
15. Consistence (choose one method) Slump Class Vebe Class Compaction Class Flow Class	S1, S2, S3, S4, S5 V0, V1, V2, V3, V4 C0, C1, C2, C3 F1, F2, F3, F4, F5, F6			
16. Method of placing (for information)				
17. Other requirements by the purchaser of fresh concrete (only if appropriate)				

8 BLOCKWORK AND BRICKWORK

SPECIFICATION FOR BLOCKWORK AND BRICKWORK

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PREAMBLE:

This specification contains seven pages.

Where the contract to which this specification is being applied is of any form other than the RIAI Standard Form of Contract, then all references herein to 'the Architect' shall be deemed to be replaced by an equivalent reference to 'DBFL Consulting Engineers'.

For Facing Brickwork, this specification shall be used in conjunction with the separate document 'Specification for Facing Brickwork'.

References herein to Irish Standards, IS European Standards and British Standards do not give year of issue or dates of amendment. The latest relevant published version including any relevant amendments shall apply.

References herein to the other specifications shall be to DBFL specifications unless noted otherwise.

Where the preambles to the Bills of Quantities and the Standards referred to herein are at variance, the more onerous requirement shall take precedence.

Requirements of the Building Regulations shall take precedence over any requirement referred to herein.

01. General

1. All blockwork and brickwork shall be carried out in accordance with ISEN1996 & SR325 unless otherwise specified herein or directed by the Architect.

2. Concrete Blocks

1. All blocks shall be in accordance with IS EN 771-3 and shall be obtained from an approved manufacturer. They shall have a co-ordinating size of 450mm x 225mm and shall be as described on the Architect's drawings.
2. All aggregates shall be in accordance with IS EN 12620 and SR16.

Aggregates are to have Freeze-Thaw category of F2 or MS25.

The maximum fines content of partially crushed or crushed gravel sand is to be 3%.

Unless certified for use in blockwork by a Professional Geologist to BS812-104, the aggregate is to have the following requirements:
 - maximum Total Sulphur of 0.25%
 - maximum Acid Soluble Sulphur of 0.1%
 - maximum argillaceous content of 10%.
3. All blocks are to be Category I to IS EN 771-3 and Group 1 or 2 to ISEN1996-1-1. The minimum declared characteristic air-dry strength of a 440x100x215 block tested on edge is to be 7.5N/mm². The minimum declared characteristic air-dry strength of a 440x215x215 hollow block is to be 7.5N/mm². All other units are to have a minimum characteristic normalised strength of 10.5N/mm².
4. Where blocks of equal size but different strengths are to be used on the same site, all except those of the lowest strength shall be differently pigmented at manufacture to distinguish between strengths. Paint sprayed on the faces of blocks will not be adequate for this distinction.
5. Dense masonry blocks shall be waterproofed dense concrete masonry blocks and approved complying with the requirements of IS EN 771-3. The blocks shall be to selected colour or colours as directed by the Architect.
6. All autoclaved aerated concrete masonry blocks shall be in accordance with IS EN 771-4.

03. Bricks

1. All bricks shall be in accordance with BS 4729 and IS EN 771
2. All clay bricks shall be in accordance with IS 91: Clay Bricks and IS EN 771-1
3. All concrete bricks shall be in accordance with IS 189: Concrete Bricks and IS EN 771-3
4. All calcium silicate bricks shall be in accordance with IS 190: Calcium Silicate Bricks IS EN 771-2

04. Handling and Storage

1. Blocks & bricks shall be off-loaded and moved to laying position mechanically. They shall be stored off the ground and covered to protect from rain and dirt.

05. Certificates

1. A manufacturer's declaration of conformance and CE mark of the blocks, bricks and aggregate shall be produced for all batches of blocks delivered to site. The system for attestation or conformity is to be "2+".

06. Cement

1. Cement used in mortars shall be either Portland Cement to IS EN 197 or sulphate resisting cement to BS 4027. The use of high alumina cement is forbidden. Where masonry cements are permitted by the Architect in lieu of cement and lime they shall comply with BS 4551 and in any event they will not be permitted for mortar mixes stronger than 1:1:6 cement:lime:sand.

07. Lime

1. Lime used in mortars shall be non-hydraulic (calcium) limes or semi-hydraulic (calcium) and magnesium limes to conform to the requirements of IS 8.

08. Sand

1. The sand shall be free from deleterious substances and shall comply with the requirements for quality and grading of sand for mortar given in IS EN 13139 and SR18.

09. Water

1. Water shall be free from impurities harmful to the mortar. Where the quality of supply is doubtful the water shall be tested in accordance with IS EN 1008.

10. Admixtures

1. Admixtures, may be used subject to the Architect's approval in writing.

11. Mortars

1. An M4 factory made designed mortar to IS EN 998-2 (Designation (iii) - 1:1:6 Cement:Lime:Sand) mortar shall generally be used in the superstructure. However where special conditions, either constructional or environmental prevail, attention must be given to the requirements of BS5628 Part 3 : Table 12.
2. The mortar shall be waterproofed and tinted if so required by the Architect. Special care shall be taken to maintain consistency of mortar.

12. Batching and Mixing of Mortars

1. The material for the mortar shall be measured accurately to conform with the specified mix proportions by weigh batching or by the use of gauge boxes.

2. The mortars shall be mixed by machine.
3. Mortars containing cements shall be used within two hours of the mixing of the cement and water and any mortar not then used shall be discarded and not re-tempered.

13. Filling of Cores, Etc

1. Where the cores of block walls are to be filled with concrete a 10mm aggregate concrete as elsewhere specified shall be used.
2. These cores shall be accurately lined up and be clean and clear of all protruding mortar etc.
3. The concrete shall be well tamped around the reinforcement to ensure that it is fully compacted.

14. Wall Ties

1. Cavity wall ties shall be approved safety stainless steel ties in accordance IS EN 845, with restraining clips to restrain the insulation unless otherwise directed by the Architect. The declared mean load capacity of wall ties shall be to SR325 Annex D Table D.1 unless noted otherwise.
2. Internal collar jointed walls shall be tied together with flat stainless steel ties of cross sectional area over 20mm x 3mm at centres not exceeding those in the attached table.
3. Suitable ties shall be provided at 450mm centres on the face of all reinforced concrete or steel columns or posts or walls where brickwork or blockwork abuts to enable the brickwork or blockwork to be tied thereto, one end of the tie being fixed to the concrete or steel face by an approved fixing and the other end being built into the joint of the brickwork or blockwork for a length of 150mm.

15. Handling and Storage of Materials

1. Cement shall be stored to ensure that it is not affected by dampness prior to use.
2. Sand shall be stored separately according to type where it will not be contaminated.
3. Reinforcement and ties shall be protected from becoming contaminated.
4. Facing blocks and bricks shall be carefully unloaded so as to avoid damage to the units. All blocks shall be stacked on prepared level areas to ensure that the stack is stable. Blocks used for fairfaced work shall be protected to prevent the exposed faces from becoming stained or marked. Precautions shall be taken to ensure that the manufacturer's recommended moisture content is not exceeded at the time of laying.

16. Testing of Blocks

1. Independent testing of blocks shall be carried out in accordance with IS EN772-1.

17. Workmanship

1. All blockwork and brickwork shall be set out and built to the respective dimensions, thickness and heights shown upon the drawings.

2. All perpend, quoins, joints, etc., shall be kept strictly true and square, other angles shall be plumbed and the whole properly bonded or tied together and the bed joints levelled as the work proceeds.
3. Blockwork and brickwork shall be built to the bond indicated, on the drawings. Where no bond is indicated, the units shall be laid in stretcher bond.
4. Blocks used for facing shall be cut with a masonry saw. Where it is necessary to cut the blocks wet they shall be dried to the manufacturer's recommended moisture content before being built into the wall.
5. The positions and size of the chasings shall be as indicated on the drawings and shall be carried out neatly using a chasing tool.
6. Blocks or bricks should be used at a moisture content not exceeding the manufacturer's recommendations.
7. All painting of blockwork shall be carried out to the detail agreed with the Architect.
8. No block or brick laying shall be carried out when the temperature is at or below 3 deg.C unless precautions are taken to ensure a minimum temperature of 4 deg.C in the work when laid and thereafter to maintain the temperature above freezing point until the mortar has hardened. Should any block wall be damaged by frost it shall be pulled down and made good at the contractor's expense. Walls shall, where necessary, be adequately braced during construction to prevent damage by winds or other causes.
9. Each block shall be laid and adjusted to its final position while the mortar is still plastic.
10. All blocks and bricks shall be laid on a full mortar bed. Vertical joints shall be filled. All joints are to be nominally 10mm thick.
11. Any mortar which extrudes from the joint of fairfaced units shall be cut away and on no account is mortar to be smeared on to the face of the unit.
12. The junctions of all walls shall be block or brick bonded unless specified or directed otherwise by the Architect. Junctions of walls which are not thus bonded shall be tied together as for masonry abutting concrete - see clause 14:3 above.

18. Control Joints

1. Control joints shall be constructed as indicated on the drawings or as directed by the Architect. Expansion joints shall be cleaned out to ensure that mortar does not bridge the joint, and shall be filled to the thickness indicated with an approved compressible material and shall be sealed with a polysulphide seal, coloured to the Architect's specifications.

19. Double Leaf (Cavity) Walls

1. The walls shall be built with cavities of the width shown on the drawings and tied together with wall ties as specified embedded in the mortar at least 50mm. Unless otherwise detailed the wall ties shall be staggered in alternate courses and spaced in accordance with Table 1 of this specification.
2. The spacing may be varied provided that the number of ties per unit area is maintained subject to the Architect's approval.

3. Additional ties shall be provided in every course within 225mm of openings and on each side of control joints. Ties shall be laid falling to the external leaf.

TABLE 1. MAXIMUM SPACING OF TIES			
Lesser Leaf Thickness mm	Cavity Width mm	Maximum Horizontal Tie Spacing mm	Maximum Vertical Tie Spacing mm
Less than 90	50-75	450	450
90 or more	50-75	900	450
90 or more	75-100	750	450
90 or more	100-150	450	450

4. The cavity, ties and cores (where they are to be filled with concrete) shall be kept clear and clean of mortar droppings or other materials during construction and any extruding mortar shall be struck off flush. No cavity shall be sealed off until inspected and approved by Architect.
5. Weepholes 10mm wide by 75mm high, spaced at centres not exceeding 900mm and extending through the vertical mortar joints of the outer leaf shall be provided at ground level and at positions where the cavity is bridged or at locations indicated on the drawings.
6. Vent holes shall be of the dimension as for weepholes and shall be positioned at locations indicated on the drawings.
8. Insulation in cavities shall be in accordance with Architects' details and with current Building Regulation Requirements.

20. Partitions

1. Partitions shall not be built on suspended slabs until after the props have been removed.

21. Lintels

1. Concrete block lintels shall be positioned and reinforced in accordance with the details shown on the drawings and shall have cavities filled with concrete as specified. The lintels are to be propped during construction to the satisfaction of the Architect.
2. All lintels shall have a minimum bearing length of 200mm on a solid whole unit unless otherwise detailed.

22. Protection

1. Where necessary walls shall be temporarily braced to prevent damage from backfilling operations.
2. The tops of constructed walls shall be protected from rain and in addition fairfaced work shall be protected against staining from construction activities.

3. At the completion of the work all temporary holes in mortar joints of fairfaced work shall be filled with mortar and suitably tooled. Any damaged masonry shall be repaired with approved materials or replaced to the satisfaction of the Architect.

23. Sealing

1. Joints around door and window frames, control joints, abutting joints at external columns and other joints where sealing is indicated or required shall be brush painted with an approved primer and filled with an approved sealant of colour specified by the Architect, the whole of which shall be carried out in accordance with the manufacturer's recommendations.

24. Flashings

1. Wall flashings shall be built into or secured to the blockwork in accordance with the details shown on the drawings. Care shall be taken to ensure that the flashing has adequate laps.

25. Chases

1. No chases shall be provided or cut in the blockwork or brickwork without the prior approval of the Architect. Where chases have to be cut, suitable power tools which do not operate by heavy impact should be used. The depth of chase should not exceed one-sixth of the thickness of a single leaf. No chases are permitted in hollowblock units.

26. Damp Proofing

1. Horizontal damp-proof courses shall be provided at positions shown on the Architect's drawings and be positioned so as to fully cover the leaf thickness. All horizontal damp-proof courses shall be laid on an even bed of fresh mortar and eventually covered by mortar so as to maintain regular coursing and joint thickness and while exposed shall be protected from damage while the building is proceeding.
2. Stepped damp-proof courses at openings shall extend beyond the end of the lintel by at least 100mm.
3. All horizontal damp-proof courses shall protrude 10mm from the external face of the wall and be turned downwards.
4. Vertical damp-proof courses shall be of adequate width and be fixed so as to separate the inner and outer leaves of the wall.
5. Damp proof course shall be bitumen with hessian base and shall comply with IS 57 or equivalent unless otherwise directed by the Architect.
6. Lead lined damp proof courses shall comply with BS 743, BS 6398, BS 6515, BS 8215.
7. Horizontal damp proof courses in blockwork of block strength greater than 7.5 N/mm² (when tested on edge) or brickwork of brick strength greater than 15 N/mm² (when tested on edge) shall be of high load type, capable of withstanding, and suitable for, an applied pressure of 7.5 N/mm².

27. Stability During Construction

1. Walls in the course of construction shall be propped by the contractor to ensure stability and resist all lateral forces until such time as they have been adequately braced by the completed or partially completed structure.

28. Backfilling

1. Backfilling shall not be placed against masonry walls within 14 days of completion of the construction unless otherwise directed by the Architect. Vehicles shall not be operated closer to the wall than a distance equal to the height of the wall below ground level.

29. Firebrick Lining to Chimneys

1. Firebrick chimney lining shall be an approved insulating firebrick built in fireclay and flat pointed as the work proceeds.

30. Pointing of Blockwork

1. Pointing should be carried out from the top of the wall downwards. The joints shall be well brushed to remove dust and loose material and should be lightly wetted using a brush. The type of pointing shall be as directed by the Architect.

31. Sample Panels

1. Sample panels of walling, if required by the Architect, shall be constructed in accordance with this specification at the commencement of work. These panels shall remain on site for the duration of the Contract unless otherwise directed by the Architect.

32. Tolerances for Blockwork & Brickwork

1. The following tolerances shall apply to blockwork except specified by the Architect.

Level $\pm 10\text{mm}$ for dimensions to any nominally horizontal surface measured from the nearest reference level but not more than $\pm 3\text{mm}$ under a 3m straight edge.

Position on Plan $\pm 10\text{mm}$ for dimensions to any nominally vertical surface at the lower edge measured horizontally from the nearest reference line.

Plumbness $\pm 5\text{mm}$ in any 1m but not more than 20mm except at window, door and other formed opes where a tolerance of $\pm 5\text{mm}$ in the height of the ope on any nominally vertical face shall not be exceeded.

Cross-Section of Elements $\pm 5\text{mm}$ unless otherwise indicated on the drawings or in this specification.

Straightness $\pm 10\text{mm}$ measured horizontally at any level but not more than $\pm 3\text{mm}$ under a 3m straight edge except where otherwise specified.

Joint Thickness

- (i) Horizontal joints - $\pm 3\text{mm}$ but not more than $\pm 10\text{mm}$ for the combined thickness in any 1m height for normal work. For unplastered blockwork exposed to view this tolerance shall be $\pm 1.5\text{mm}$ but not more than $\pm 5\text{mm}$ for the combined thickness in any 1m height.
- (ii) Vertical joints - $\pm 3\text{mm}$ but not more than $\pm 10\text{mm}$ in any 3m length for normal work. For unplastered blockwork exposed to view this tolerance shall be $\pm 1.5\text{mm}$ but not more than $\pm 5\text{mm}$ for the combined thickness in any 3m length.

Openings in Blockwork Notwithstanding the tolerances stated elsewhere, the permissible deviation in the specified dimension of the opening shall be $\pm 5\text{mm}$.

33 Tolerance for Blocks

- 1. The tolerance applying to individual blocks shall be D2 to IS EN 771-3 Table 1 as follows :

Length	+1mm/-3mm
Width	+1mm/-3mm
Height	+2mm/-2mm

34 Collar Joined Walls

- 1. Provide block ties between both leaves of 215mm thick collar joined walls. Ties to be flat stainless steel, 125mm long x 20mm x 3mm thk, at 450mm c/c each direction.
- 2. 15mm thk collar joint to be mortar filled as block-laying proceeds.

9 STRUCTURAL TIMBER WORK

1 General

Structural timber elements shall be clearly identified on structural drawings and if applicable for this development the following notes shall be adhered to:

1. Timber terms are those of BS 6100: Part 8 and timber species are the standard names of ISEN 13556.
2. Structural timber design shall, in general, comply with IS EN 1995 –“Design of Timber Structures” together with Standard Recommendations SR70 (Trussed Rafters) and SR71 (Span Tables and Guidelines).
3. Domestic timber shall comply with IS 444 and shall be of minimum grade C16.
4. Timber plywood decking shall comply with ENs 13986 & 14374.
5. Trussed rafter roofs shall comply with ISEN 1995 and IS 193.
6. Glued laminated structural timber members shall comply with ISEN 14080.
7. Timber connectors shall comply with ISEN 912.

2 Quality Management

1. Quality Control Documentation

Contractor is referred to Section 1.4 of this specification for guidance to conform with the current EU directives in relation to control standards for construction products.

2. The species group and stress grade shall be marked on all timber. All timber re-sawn from stress graded stock shall be regraded before use.
3. All general structural timber on site must be marked to identify its stress grading. Any timber not marked shall be rejected.

3 Project-specific Clauses

1. These notes to be read in conjunction with relevant DBFL Consulting Civil & Structural Engineers and Architects drawings and specifications.
2. Grade of timber for individual timber sections shall be stated on the relevant DBFL Consulting Civil & Structural Engineers drawings.

4 Type and Grade of Timber & Connectors to be used

1. Unless noted otherwise, special structural timber shall have a minimum grade class C18 in accordance with Tables 1 & 2 of IS 444 and shall be stress graded to SS Grade in accordance with IS EN 14081, IS EN 1912, irrespective of any other grading carried out at source.

2. Unless noted otherwise, normal domestic timber shall fall within strength class C16 in accordance with Tables 1 & 2 of IS 444 and shall be graded to GS grade in accordance with IS EN 14081, IS EN 1912, IS EN 338, IS EN 384, BS 4978.
3. Unless noted otherwise, softwood glued laminated timbers shall be strength graded in accordance with IS EN 14081 and hardwood glued laminated timbers shall be strength graded in accordance with BS 5756.
4. All steel plates and connectors forming part of timber construction shall be hot dip galvanised to IS EN ISO 1461.
5. All steel bolts shall be electro-galvanised to BS3382:Part 2.

5 Dimensions

1. Timber dimensions in general, which are shown on the drawings or referred to elsewhere, shall be basic sawn sizes unless otherwise indicated or where the details dictated otherwise. In particular member sizes shown for all laminated beams are finished sizes.

6 Tolerances

1. The permissible dimensional deviations for timber work generally shall be as specified in BS 5268, IS EN 1313 and IS EN 336.
2. In the case of trussed rafters the maximum difference in thickness of abutting pieces shall not be greater than 1mm.

7 Plane and Regularised Timber

1. Reductions from basic sawn sizes and permissible deviations are given in IS EN 1313 and IS EN 336.
2. After planing softwood already graded to IS EN 14081, IS EN 1912, IS EN 338, IS EN 384, BS 4978 shall be re-marked.

8 Finish to Timber

1. All timber exposed to view shall be planed and sanded on four sides prior to fabrication. In the case of laminated beams all machining is to be done after gluing. No cutter or sanding marks are permissible. In exposed surfaces voids shall be filled, glued inserts shall be selected with care to match grain and colour.
2. Outside laminations of glued laminated timbers shall be free from loose knots and open knot holes. The timber for outside laminations shall be selected with reasonable care to match colour and grain at edge points.

9 Limits to Defects for Constructional Purposes

1. In the process of assembly and construction the appropriate stress graded softwood shall be selected so that no defect permitted by such grading prejudices the strength of the completed structure at bearing joints and other assemblies.

10 Limits to Distortion

1. Any piece which is bowed, sprung, twisted or cupped in excess of the limits set out in IS EN 386, IS EN 391, IS EN 392 or BS5756 shall be rejected.

11 Preservative Treatment

1. Timber members shall be pressure impregnated with an approved preservative applied in accordance with the recommendations of BS 5268:Part 5 - "Preservation Treatment for Construction Timbers".
2. In the case of laminated beams and other exposed timbers, the Architect's approval shall be obtained before the application of the preservatives.
3. Where further cutting is required to previously treated compounds, preservative shall be applied to those areas so cut to ensure that the entire member is treated before incorporation in the works.
4. The Contractor shall ensure the compatibility of all preservative, glue and structural timbers retardant coatings and he shall also ensure that no corrosive effects to metal plates, connectors or bolts shall result from their use.

12 Moisture Content

1. The moisture content at the time of fabrication shall not exceed 18%. Adequate measures shall be taken to ensure that the moisture content does not rise above 20% during transportation, storage or erection.

13 Protection and Storage of Timber

1. Timber members shall, at all times, be protected from damage, staining, decay, insect attack and avoidable exposure to the weather.
2. The Contractor shall prepare a level clean site for the storage of the timber members.
3. The members shall be stacked on timber shims such that no bowing or damage takes place and they shall be protected against exposure to rain and extremes of temperature.

14 Inspection of Timber Members

1. The Contractor shall afford the Architect or his representative every assistance in the inspection of timber members during all stages of fabrication and erection. Any member found to be, or suspected of being defective shall be replaced or test loaded to the Architect's satisfaction at the Contractor's own expense.
2. The Contractor shall keep an approved type of moisture meter in his works for the control of the moisture content and for the use of the Architect at the time of inspection.

15 Testing of Members

1. The Architect may require sample members to be test loaded to confirm the adequacy and compliance with specification. Such testing where required shall be carried out by the Contractor, or approved testing authority, in accordance with the relevant code of practice and to the Architect's satisfaction.

16 Erection of Members

1. The Contractor shall at all times have a competent foreman in charge of the erection of the timber members who shall ensure that the work is carried out in accordance with the drawings, the aforementioned specifications and the supplier's recommendations. Any irregularities or inconsistencies shall be brought to the Architect's attention.

17 Handling of Members

1. Care shall be taken at all times to ensure that the members suffer no damage or overstressing while they are being loaded, unloaded or lifted into position. Special care shall be taken to avoid damage to the sides and arises of members by lifting slings.

2. In all cases the suppliers' recommendations shall be sought and complied with as a minimum precaution.

18 Temporary Bracing

1. The Contractor shall be responsible for the stability of the partially completed structure. He shall provide and fix, in addition to permanent bracing, any temporary bracing necessary for the stability of the partially completed structure. He shall arrange his programme of erection so that no part of the structure is unduly exposed to possible loading in an unpropped or partially propped state.

19 Lateral Stability of Joists and Rafters

1. In relation to the lateral stability of joists and rafters the recommendations given in Sections 7.9.4 and 7.9.5 respectively of SR71 shall be complied with.

2. Specifically, joists shall be provided with solid bridging at centres along the span not exceeding 1350mm for spans over 2.5m unless otherwise agreed with the Engineer.

3. Care shall be taken to ensure that the ends of all joists are restrained by the masonry, joist hangers or end bridging.

4. In the case of flat roofs, the provision of lateral stability should not compromise the ventilation of the roof space.

5. All rafters shall be provided with mid-span bridging not exceeding 0.75 times the depth of the rafter leaving a 0.25 depth gap at the top of the rafter.

6. Solid bridging should be at least 0.75 times the joist depth.

7. Herringbone strutting, where permitted by the Engineer, shall use timber with a target dimension of 36mm and shall not be used where the joist spacing is greater than 3 times the joist depth.

20 Timber Trusses and Trussed Rafters

1. In the clauses below, the term trusses include trussed rafters.
2. The Contractor shall nominate specialist suppliers for the trusses. The appointment of these suppliers shall be subject to the Architects approval.
3. The truss supplier shall supply and deliver to site all trusses and associated loose timbers and bracing.
4. The Contractor shall provide timber wallplates or equivalent supports for the trusses. These timber wallplates or equivalent supports shall be detailed and fixed to the rest of the structure in accordance with the Architects and DBFL drawings.
5. The truss supplier shall check all relevant dimensions on site before manufacturing the trusses and associated timber members.
6. Cranage and storage of trusses and associated timbers shall be by agreement between the Contractor and the truss supplier.
7. The trusses shall be designed by the truss supplier to suit the Architect's overall roof profiles and roof details and requirements for fire resistance. The truss supplier shall provide, not less than 2 weeks before manufacturing the trusses, 2 copies of calculations and drawings which are adequate:
 - i) for checking by the Architect (see below), and
 - ii) for checking by DBFL (see below) and
8. Calculations shall be adequately cross referenced and shall include sufficient manual calculations and summary sheets to show:
 - i) all structural models of individual elements, and
 - ii) all structural models of overall roof behaviour, and
 - iii) all loadings used, and
 - iv) all vertical, horizontal, and uplift reactions on all supports, and
 - v) all materials used, and
 - vi) all design assumptions.

Where element or connection strengths are based on testing rather than on elastic or plastic design, appropriate Agreement Certificates should be provided by the timber roof specialist subcontractor. Design and detailing of the trusses shall incorporate appropriate bracing.

9. Loadings used in the design of the trusses shall be in accordance with BS6399: Part 1, BS 6399: Part 2 and BS 6399 : Part 3. Dead loads of roof materials used in design shall be appropriate for the roof materials indicated on the Architect's drawings and in the Architect's specification. If the final choice of roof materials is unresolved at the time of designing the roof structure, the design shall allow for the lightest and for the heaviest roof materials still under consideration. Loads due to services and water tanks used in design shall be appropriate for these items as indicated on the Architect's drawings and in the Architect's specification, but also chosen to allow normal flexibility in accordance with ISEN 1995 and IS 193. Attention should be given to the effects of drifting of snow in valleys, both between pitched roofs and between pitch roofs and vertical walls, and to wind loads.

10. Checking by DBFL of calculations & drawings shall not remove from the truss supplier any of his responsibilities for providing trusses & associated timbers which are adequate in respect of: Dimensional Accuracy, Stability, Strength, Serviceability, Buildability, Durability and any other requirement contained in this document. In particular, checking by DBFL shall be an overall check concerned with whether or not the roof structure is in accordance with the principles contained in this document, and whether or not it has been designed using span dimensions accurate enough for engineering design. Exact dimensions and setting out will not be checked by DBFL.

10 STRUCTURAL STEELWORK

1 General

1. Relevant Standards:

The specification for structural steelwork shall comprise the National Structural Steelwork Specification (NSSS) as published by and available through The British Structural Steelwork Association (www.steelconstruction.org) together with IS EN 1090-1 – “Execution of Steel Structures and Aluminium Structures-Part 1: Requirements for conformity assessment of structural components” and IS EN 1090-2 – “Execution of Steel Structures-Part 2: Technical requirements for steel structures”, with information, amendments and particular requirements as set out in this section (Section 13 – Structural Steelwork) of the Project Specification. Where there is conflict with the NSSS, the Contract Documents, other standards and/or codes of practice, the requirements of this Project Specification shall take precedence over other requirements.

2. Unless specified otherwise, steel shall be minimum grade S355 to IS EN 10025 and IS EN 10210 (hot rolled). All external steelwork shall be subgrade JO.

3. Unless specified otherwise, steel in Cold Store structures shall be subgrade J2.

4. Unless specifically stated by the Engineer, Execution Class 2 (EXC2), in accordance with IS EN 1090-2, shall be applied to all steelwork.

5. Before any work commences the Structural Steelwork subcontractor shall provide, for the approval of the Engineer, the following current and authentic documentation: -

- i) Factory Production Control (FPC) Certificate.
- ii) Welding Test Certificate.
- iii) Sample Declaration of Performance (DOP).
- iv) Responsible Welding Co-Ordinator and Cert Number.
- v) CE Certification.

6. During the execution of the works the Steelwork Contractor shall maintain strict Quality Management procedures and shall obtain and produce for the inspection of the Engineer all statutory documentation and mill certificates relating to the steelwork.

7. In all cases where reference is made to “Engineer’s Approval” such approval does not absolve or diminish the Steelwork Contractor’s responsibility for the design, fabrication and erection of the steelwork.

2 Quality Management

1. General:

The Structural Steelwork subcontractor, whether Domestic or Nominated, shall be bound by the same quality management and control measures governing the Main Contractor.

2. Quality Control Documentation:

The Structural Steelwork Sub-Contractor is referred to Section 1.2 of this specification for guidance to conform with the current EU directives in relation to control standards for construction products. In addition to the items outlined in Section 1.2 of this specification the Steelwork Sub-Contractor must provide proof of the following:

- i) Factory Production Control Certificate (FPC).
- ii) Welding Test Certificate.
- iii) Sample Declaration of Performance.
- iv) Responsible Welding Co-Ordinator and Cert Number.
- v) CE Certification.
- vi) Ancillary Certificates (Design and Install depending on tasks undertaken by specialist).
- vii) Steelwork Mill Certificates (confirming steel grade).
- viii) FM01 / 02 / 03 forms for anchor specification/design/install as relevant.

3. Suitability of Steelwork subcontractor:

The Employer's Representative shall be afforded ample time and facilitation to vet the Steelwork subcontractor and shall be provided with all appropriate quality control documentation well in advance of the Contractor's intention to proceed with a particular subcontractor.

4. Welding:

A welding quality management system shall be put in place that complies with ISO 3834-1.

3 Amendments to NSSS Standard Specification

1. The amendments and clarifications to the NSSS Standard Specification to suit the specific requirements of this project are set out in the following table and elsewhere detailed within this Project Specification:

NSSS Section/Clause Reference Change

N: New

D: Deleted

M: Modified

C: Clarification Description

Section 1 C Information required by the Steelwork Contractor

- All information will be provided to Steelwork Contractor by Main Contractor in accordance with Engineer's specification and subject to Engineer's approval.
- Engineer's design drawings will show all member sizes and critical connection arrangements.
- Steelwork Contractor's drawings to show all member arrangements and details which will be subject to Engineer's approval.
- Steelwork Contractor to design and detail all steelwork connections which will be subject To Engineer's approval.

- Steelwork Contractor to be responsible for temporary stability of steelwork during erection and until structural shell is complete.
- Steelwork Contractor to liaise with Main Contractor with regard to programme for delivery and erection.

4.6.6 M Slotted Holes

Add the following:

Slotted holes shall only be provided on the specific approval of the Engineer.

Under no circumstances shall a member or plate be slotted where there is a component of load in the direction of the slot.

5.1 M Workmanship – Welding – General

Add the following:

Structural sections shall be arranged so as to minimise the number of butt welds particularly in primary members where splices, where unavoidable, should be positioned away from locations of high stress.

5.5 C Non-destructive testing of welds

Apart from 100% visual inspection of welds, a schedule of non-destructive testing (NDT) of welds shall be drawn up by the Steelwork Contractor for approval of the Engineer. This testing schedule will prioritise critical butt welds above fillet welds and should be representative of the weld arrangement throughout the project.

8.1.7 N Checking on site prior to delivery of steelwork

Notwithstanding what is stipulated in Clauses 8.1.3 & 9.2 the Steelwork Contractor shall arrange a joint inspection with the Main Contractor of the setting out of the building 7 days before delivery of steelwork. Any deviations outside normal tolerances as elsewhere defined shall be brought to the attention of the Engineer who shall request remediation proposals jointly from the Main Contractor and Steelwork Contractor

11.1.2 C Quality Management – System acceptance

The acceptance system shall be as defined under 11.1.2 (i).

4 Workshop and Erection Drawings

1. The Structural Steelwork Contractor shall prepare all the necessary workshop drawings and shall submit, not less than 2 weeks in before fabricating the steel, all drawings in duplicate to the Engineer for review. One copy of each drawing will be returned to the Structural Steelwork Contractor marked as appropriate for correction or amendment. The Structural Steelwork Contractor shall, before commencing fabrication, provide two sets of the fully approved drawings for the Engineer. The Steelwork Contractor shall remain fully responsible for the design and accuracy of the steelwork.

2. The Structural Steelwork Contractor shall not commence the fabrication of any part of the work until full approval to the workshop drawings has been given. Commenting by DBFL on calculations and drawings shall not remove from the Sub-Contractor any of his responsibilities for providing elements which are adequate in respect of: Dimensional Accuracy, Stability, Strength, Serviceability, Buildability, Durability and any other requirement contained in this document. In particular, commenting by DBFL shall be an overall comment concerned with whether or not the element is in accordance with the principles contained in this document.

3. Where tying in to existing structures is required it shall be the responsibility of the Steelwork Contractor to take all the necessary site dimensions and levels to accommodate the new steelwork.

5 Connection Design

1. The connection arrangement shown on the Engineer's drawings is to be indicative only. The Steelwork Contractor shall be responsible for the final design and arrangement of all steelwork connections which shall be subject to the approval of the Engineer.

6 Steelwork Tolerances

1. Unless otherwise agreed with the Engineer steelwork tolerances shall be in accordance with the NSS Specification and IS EN 1090 as appropriate.

7 Programme of Supply

1. The Structural Steelwork Contractor shall arrange his programme of fabrication, delivery and erection in consultation and agreement with the General Contractor and shall be prepared to amend this programme if required to do so by the General Contractor.

8 Cladding

1. The Structural Steelwork Contractor shall throughout the fabrication and erection period co-operate and consult with the Roofing and/or Cladding Contractor.

9 Site Connections

1. All site connections shall be bolted unless noted otherwise on the drawings and these connections must be agreed in advance with the Engineer. Where site welding is necessary the Structural Steelwork Contractor shall arrange to have an adequate supply of electric power.

10 Welding

1. All welding practice shall conform to the standards of IS EN 1011 and comply with the particular requirements of the NSSS for Building Construction.
2. The Structural Steelwork Contractor shall provide for the Architect's or his representative's approval a written specification of the type of electrodes and welding procedure he proposes to adopt.
3. All welding shall be a minimum 6mm fillets unless otherwise directed.
4. Rutile electrodes to IS EN ISO 2560.
5. All electrodes shall be handled and stored with care to avoid damage; electrodes with damaged coatings must not be used and the manufacturer's instructions regarding protection and storage must be followed.

6. Where low hydrogen electrodes are being used, they must be oven dried immediately prior to use in the manner recommended by the electrode manufacturer. The manufacturer's instructions regarding current (AC or DC) and polarity should be followed.

7. Every welding operator, before he carries out any welding in this Contract, shall pass or have passed such qualifying tests which in the opinion of the Architect or his representative will prove his competence in carrying out the welding. Welders shall be tested to meet the requirements of BS4872: Part 1.

8. The Engineer may appoint a specialist representative to supervise and check the welding and fabrication and the Steelwork Contractor shall provide all the necessary facilities for the examination of the welding.

9. Any welding considered by the Engineer to be unsatisfactory shall be rejected and the cost of replacing any such rejected material will be borne by the Steelwork Contractor.

10. All members to be welded shall be held in their correct position by jigs, bolts or clamps. The assembly of work to be welded shall be arranged so that whenever possible the work shall be done in a downhand position.

11 Preheating

1. The requirements of IS EN 1011 shall apply to all welded joints in this Contract, wherever they may be made. The minimum area over which local preheating shall be effective shall in all cases be an area extending at least 75mm or four times the thickness of the thicker part to be joined.

12 Splices

1. No splices of any description shall be used in any member without the written approval of the Engineer.

13 Inspection of Fabricated Steelwork

1. The Engineer shall have access at all times to the Structural Steelwork Contractor's workshop for the purpose of inspecting the steelwork. Any steelwork found to be unsatisfactory at workshop inspection or subsequent inspection shall be rejected and replaced at the Structural Steelwork Contractor's expense.

14 Corrosion Protection of Steelwork

1. Protective coatings of steelwork shall generally be in accordance with BS 5493, EN ISO 12944 and EN ISO 14713.

2. Where steel is specified on drawings or otherwise as galvanized, then steelwork is to be shot-blasted to standard Sa 2½ of IS EN ISO 8501-1 and unless specified otherwise, hot dip galvanized to a thickness of 140 microns thick and in accordance with IS EN ISO 1461.

3. Where steel is not specified on drawings or otherwise as galvanized, then unless specified otherwise the corrosion protection system shall be as described in the relevant clauses of this specification.

4. All Steelwork shall be shot-blasted to standard Sa 2½ of IS EN ISO 8501-1.

5. After shot-blasting remove all traces of loose rust, grit etc. by compressed air hose or careful clean dry brushing. Remove all laminations by careful grinding leaving the surface smooth.

6. Priming of the clean blast steel should be carried out within 2 hours of shot-blast. The blast primer shall be a 2-pack epoxy zinc rich primer applied by airless spray to give a minimum dry film thickness of 25 microns.
7. After fabrication, carefully remove all weld spatter, rough edges etc. by grinding, chipping and scraping, and grind to a smooth surface. Remove any unsound primer around weld areas.
8. The site holding primer shall be a high-build zinc phosphate modified alkyd primer applied by airless spray to give a minimum dry film thickness of 75 microns.
9. After erection all site contaminants shall be removed, and the steelwork shall be patch primer if required with the specified primer. All nuts and bolts shall be degreased and coated with one coat of the primer.
10. All painted steelwork shall be inspected and certified by an independent paint specialist who shall report his findings to the Engineer.

15 All Externally Exposed or Partially Exposed Steelwork

1. Partially exposed steelwork includes all steelwork outside the vapour barrier or in the cavity.
2. Steelwork shall be shot-blast to Sa 2½ (maximum surface profile 100 microns) and painted with primer to a minimum dry film thickness of 50 microns.
3. An intermediate coat to a minimum dry film thickness of 200 microns shall be factory-applied.
4. Finally, a top coat shall be applied to a minimum dry film thickness of 50 microns to the Architect's colour requirement.
5. All painted steelwork shall be inspected and certified by an independent paint specialist who shall report his findings to the Engineer.

16 Treatment of Existing Steelwork

1. All external existing steelwork that requires corrosion protection shall be sealed off from public spaces by a dust-proof housing before any preparation work commences. Areas of steel to be treated shall be thoroughly cleaned down by wire brushing and then shot-blast using appropriate blast material to achieve the standard Sa 2½ in accordance with EN ISO 12944-4.
2. All internal existing steelwork that requires corrosion protection shall be at first thoroughly cleaned and wire brushed. If further preparation is required to achieve the standard Sa 2½ then the area be locally cordoned off and sealed before proceeding with shot-blasting.

17 Holding Down Assemblies

1. The Structural Steelwork Contractor shall provide all necessary holding down bolts as shown on the drawings and the rates shall include for the supply and delivery of these bolts in advance of the delivery of the steelwork.
2. The Structural Steelwork Contractor shall discuss and agree with the Contractor how best to position and secure the holding down assemblies in advance of any concreting to ensure that adequate anchorage and tolerance is achieved.

3. Baseplates shall be provided with holes as necessary for pressure grouting, escape of entrapped air or direct compaction of the filling/bedding material.

18 Anchor Bolts

1. The use of proprietary anchor bolts for the fixing of steelwork shall require the prior agreement of the Engineer.
2. The Steelwork Contractor shall liaise and cooperate at all times with the Main Contractor and the specialist anchor supplier and designer.
3. All anchor bolts shall be to a specialist design and detail certified to ETAG 001 (Concrete) or ETAG 0229 (Masonry) and shall be in accordance with HAS 'Code of Practice for the Design and Installation of Anchors'.

19 Erection of Steelwork

1. The Structural Steelwork Contractor shall check the position, setting out and levels of all holding down bolts before erection has commenced and any difference in level or levels from those shown on the Contract Drawings shall be brought to the immediate notice of the Architect.
2. The Structural Steelwork Contractor shall provide all the plant necessary for the erection of the steelwork, but he shall submit a list and description of the plant he proposes to use to the Architect.
3. Grout used under baseplates shall be of strength not less than 50N/mm² and be in accordance with IS EN 1504-3.

20 Bolting

1. Unless specified otherwise by DBFL all bolts, and nuts shall be Grade 8.8 Grade Black Bolts to IS EN 15048. Washers shall be tapered whenever necessary to give the head and nut a true bearing.
2. All bolts shall be provided with steel washers under the nut and sufficient washer shall always be used to have the threaded portion of the bolt clear of the parent metal.
3. All bolt shanks shall project at least two threads beyond the nut.
4. All bolts, nuts and washers in external or partially external steelwork shall be stainless steel or galvanised (43 microns) to IS EN ISO 10684 in accordance with the Engineer's direction.

21 Plates

1. Unless specified otherwise by DBFL, minimum plate thicknesses used in connections shall be as follows:

All Plates	10mm
Column Cap Plates	12mm
Beam End Plates	10mm
Column Baseplates	20mm

22 Ancillary Steelwork

1. All ancillary steelwork, such as stairs, landings, balconies, formwork etc. shall be designed and fabricated by specialist qualified sub-contractors who shall prepare and submit their designs for review to the Engineer. This specialist design and fabrication will be subject to ancillary certification.
2. The design and fabrication shall, in addition to complying with this specification where relevant, shall also comply with all current relevant Standards and Codes of Practice and, in particular: -
 - i) Stairs to comply with BS 5395
 - ii) Flooring, handrails balconies to comply with BS 4592
3. Calculations shall indicate adequate capacity to safely sustain all appropriate dead and imposed loading without undue deflection or vibration to the satisfaction of the Engineer.
4. The specialist sub-contractor shall provide sufficient details and calculation to allow the fixing of the ancillary steelwork to be satisfactorily designed and detailed.

23 Temporary Bracing

1. The Structural Steelwork Contractor shall provide all necessary temporary bracing and strutting to resist erection forces and wind forces and any other temporary bracing or strutting.
2. This temporary bracing shall remain in place until such time as the permanent bracing is in place and fully effective.

24 Additional Holes

1. All members with non-vertical webs and upstanding flanges shall have drain holes, minimum diameter 10mm, maximum spacing 1000mm.
2. Any additional holes required on site shall be drilled, using appropriate equipment. Burning holes in steelwork is not permitted. No holes will be drilled until approval for such holes has been given by the Engineer.

25 Stacking of Steelwork

1. When stacking the fabricated steelwork before delivery the Structural Steelwork Contractor shall ensure that sufficient timber shims are placed between members to avoid undue bowing of the members. He shall also ensure that the steelwork is carefully unloaded and stored on site prior to erection.

11 SETTING OUT

Bench Marks

1. The Contractor shall establish a master bench mark on site for the duration of the contract.

This master bench mark shall be related to ordnance datum. The permissible deviation in level between the bench mark and ordnance datum shall be $\pm 2\text{mm}$.

02. Permanent Control

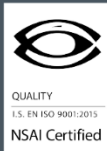
1. Before any construction takes place the Contractors shall set up a permanent control on the site. This control shall consist of concrete stations into which a brass plate shall be set as shown on the attached sketch.
2. The brass plates shall be scribed with an "x" the centre of which shall be located to an accuracy of $\pm 3\text{mm}$ in plan position and level.
3. These stations shall be generally set out at 50m intervals and each station shall be visible at all times from at least two other neighbouring stations.
4. These stations shall be maintained for the duration of the contract and should any stations be disturbed it shall be demolished and a new station erected in its place to the same specification.
5. The setting out of this permanent control shall be carried out using a 1" theodolite in combination with Electro-Magnetic Distance Measurement equipment.

03. Reference Lines Plan Dimensions

1. Reference lines for plan dimensions in setting out the Work shall be set out from the permanent control at intervals not exceeding 3.0m.
2. The permissible tolerance in the horizontal distance between two adjacent reference lines shall be $\pm 2\text{mm}$.

04. Reference Lines Vertical Dimensions

1. Reference lines for vertical dimensions in setting out the Works shall be set out from the permanent control at vertical intervals not exceeding 3.0m or at each floor and roof level whichever is less.
2. The permissible tolerance in the vertical distance between two adjacent reference lines shall be $\pm 3\text{mm}$.



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