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Substation Civil and Building Works

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1 SCOPE

The following Functional Specification describes the Architectural, Civil and Structural design and development required for 110kV, 220kV and 400kV GIS and AIS transmission substations, buildings and ancillary site development. The specification lists the minimum requirements of EirGrid. The Customer shall submit in full, the Civil design package in accordance with Section 3.8 of this Specification which shall also include all deviations from the EirGrid Specification requirements. Where deviations are proposed, the Customer shall initiate and clarify these deviations. All works to be carried out to the full satisfaction of EirGrid to match the requirements of the local authorities, including planning, building control, government services and other relevant authorities. EirGrid and its appointed agents shall be given reasonable access to site during the construction phase of the Civil and Building works.

The scope of the Civil and Structural works shall be as outlined in sections 1.1 and 1.2 below.

1.1 SUBSTATION WORKS - EXTERNAL

Work shall include but is not limited to:

- Geotechnical soil investigation and topographic survey of substation site
- Groundworks
- Terracing of the yard and retaining walls
- Crushed stone filling in the yard
- Surface water and foul drainage, treatment and disposal system including connections to main drains, if required.
- Storm water infrastructure including swales, settlement ponds, attenuation ponds / tanks,
- Security fencing and gate works
- Cable / service trenches and covers, manholes and cable ducts
- Equipment bunds
- Substation roads and access ways
- Landscaping and Hardstanding
- Substation access road from main road, including any bridges and structures required to cross waterways and ditches
- Substation yard operational lighting
- Civil works associated with the switchyard

- Earth grid
- Any other works not specifically covered, but required to provide a safe and fit for purpose outdoor switchyard.

1.2 SUBSTATION WORKS - BUILDINGS

Work shall include but is not limited to:

- Groundworks
- Foundations works
- Architectural works
- Superstructure works to include walls, masonry, flooring, roofing, cladding, finishing and painting
- Building electrical installation for lighting and power socket outlets
- Building fit-outs including platforms, ladders, suspended steel floor, etc
- Insulation and waterproofing
- Sealing and fire-stopping of openings
- Air conditioning, heating, plumbing and ventilation
- Fire detection, alarm, telephone and data
- Water supply
- Drainage works
- Any other works not specifically covered, but required to provide a safe and fit for purpose substation control building.

Detailed requirements of these works are described in the latter sections of this specification.

All works shall be carried out to the full satisfaction of EirGrid and shall be of a standard that meets the requirements of the Law and relevant authorities, including the local authority, planning, building control, government services and other relevant authorities.

2 STATUTORY REQUIREMENTS, CODES STANDARDS AND COMPLIANCE

The Customer shall be required to assume full professional liabilities with regard to fulfilment of any statutory requirements. All works shall be carried out in accordance with the requirements of this specification and the most recent and commonly used European, British or International Standard, where a corresponding Irish Standard does not exist. A list of the proposed standards to be used shall be submitted as part of the design criteria submissions. All dimensions or quantities shall be expressed in SI units.

A grant of planning permission for the development, without unreasonable conditions attached, will be required in accordance with the Planning and Development regulations 2001-2002 and in compliance with EirGrid requirements and this Specification. An Environmental Impact assessment will also be required to be submitted with the planning application for stations 220kV or higher in accordance with the Planning and Development Regulations.

In addition, there shall be compliance with the provisions of all current relevant Directives of the European Communities and the Republic of Ireland relating to design, workmanship, materials and equipment.

All works shall further comply with the requirements of the local authorities relating to planning permission, government services, National Monuments Service and any other relevant local authority.

The works shall be designed and constructed to meet or exceed the requirements of the Building Regulations and current Technical Guidance Documents (TGD's) unless any specific waiver / exemption has been received for the relevant Local Authority.

Any deviations from the Technical Guidance Documents published by the Department of the Environment, Heritage and Local Government (DoEHLG) shall be agreed with EirGrid.

It is the responsibility of the Customer to oversee compliance with current building regulations and the requirements of the Building Control Amended Regulations (BCAR) 2014.

In advance of any work taking place any proposed deviations from these standards and any later amending acts shall be agreed with EirGrid and their agents.

All equipment shall carry the CE Mark in accordance with Direction 93/465/EEC.

2.1 DESIGN STANDARDS

Designs shall be based on and conform with the latest revisions of the following European, British or Irish Standards with precedence being given to the requirements of any Irish Standard, all without exceeding settlement, deflection and stress limits:

Loading / Actions	Design in accordance with IS EN 1991
IEEE 80 - 2000	Guide for safety in alternating current substation grounding
Foundations	Design & Construction in accordance with IS EN 1997
Structural Concrete	Design and construction in accordance with IS EN 1992
Waterproofing	Design & Construction in accordance with BS 8102
Structural Steelwork	Design fabrication and erection in accordance with IS EN1993
Blockwork/Brickwork	Design & Construction in accordance with IS EN 1996-1
Structural Timber	Design & Construction in accordance with IS EN 1995
Waterproofing	Design & Construction in accordance with BS 8102
Earth Retaining Structures	Design & Construction in accordance with IS EN 1997

All standards quoted in the specification shall be the latest revisions unless agreed otherwise by EirGrid. A more comprehensive list of all standards referenced in this Specification is contained in Appendix F.

The Customer shall be responsible for the detailed design, strength and safety of the substation and compound to meet the Civil, Structural, Architectural and Environmental requirements of this Specification. The Customer shall produce and submit to EirGrid for review, full design calculations for all buildings and structures on the Site including piling (if required by the design), ground improvements, foundations, building structures and enclosures, site structures and enclosures, etc. They shall also produce and submit detailed construction drawings for these items.

The review of the Customer's drawings or calculations by EirGrid shall not relieve the Customer of any of his obligations to meet the requirements of the Specification or the responsibility for the adequacy of design calculations / drawings.

2.2 SAFETY AND HEALTH

The Customer is solely responsible for Safety on Site. The project shall be managed in accordance with the Safety Health & Welfare at Work Act 2005 and its associated regulations and or Statutory Instruments as amended from time to time including the Safety Health and Welfare at Work (Construction) Regulations 2013.

The Customer shall undertake the duties of the Client in respect of the Safety, Health and Welfare at Work (Construction) Regulations. Key duty holders (Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS)) shall be appointed by the Client in accordance with the Construction Regulations.

The Customer and their appointed PSDP and PSCS shall be responsible for compliance, preparation of and liaison with relevant bodies in respect of all documentation associated with the above regulations including but not limited to:

- Design Risk Assessments
- Temporary and Permanent Works Certificates
- Notifications to the HSA (AF1 & AF2)
- Preliminary and Construction Stage Safety & Health Plans
- Safety File

2.3 HAZARDOUS MATERIALS / CONTAMINATED SOILS

All hazardous materials / contaminated soils shall be removed from site to an appropriate licensing facility. The treatment of hazardous materials / contaminated soils encountered in site clearance shall comply with all statutory, relevant legal and other requirements.

2.4 AS-BUILT / LAID RECORDS

As Built drawings shall be provided for all structures. As built records shall be provided explicitly for handover to EirGrid as follows:

- A minimum of 2 no. diagonally opposite ITM coordinates for each structure. Additional points shall be required where a structure has step changes along its profile
- A clean copy of the latest revision of the construction drawings marked up in red pen showing clear and legible as built dimensions. Structures shall be dimensionally referenced, in 2 orthogonal directions, to pre-existing structures within the station.
- For as-constructed pipeline records see also the specific requirements detailed under Pipework.
- For Electrical Cable Ducting as-laid records see also the specific requirements detailed under Ducting.

As Built drawings shall be submitted in electronic format (e.g dwg, dwn) and stamped or otherwise identified as 'as-built' and be fully verified and approved by the Customer within 3 months of practical completion of the project. The Customer shall be aware that it is essential that appropriately detailed and relevant drawings are provided to facilitate future maintenance and operation of the asset.

2.5 CONSTRUCTION PRODUCTS

In compliance with the Construction Products Regulation (EU) No 395/2011 (CPR), as from 1st July 2013, all construction products covered by a harmonized European product

standard (hEN) shall have Declaration of Performance (DoP) and a CE mark in order for them to be placed on an EU market. The Customer shall comply with the CPR. This requirement applies throughout this Specification where hEN is applicable.

3 REQUIREMENTS/DESIGN CRITERIA

3.1 GENERAL

The Works shall be designed by a competent and suitably experienced person, (Chartered Engineer or Registered Architect) experienced in the design of similar works who shall be fully responsible for the design and supervision of the Civil and Building Works.

The Customer's Designer shall be competent and shall be a suitably experienced Engineer [and Architect where appropriate] with experience of similar projects. Engineers shall be Chartered Civil / Structural Engineers and Architects shall be registered with the RIAI or similar professional institution.

The Civil and Building works designs shall adhere to the above listed standards and shall take into account all climatic and environmental conditions on site including exposed locations, high humidity and marine environments and shall include all loads (dynamic and static) which may also be present. The designs shall be submitted to EirGrid prior to the commencement of any works on site, and shall demonstrate how they comply with the listed standards.

In carrying out the design obligations, including the selection of materials and plant to the extent that those are not specified, the Customer's Designer / Engineer shall ensure that all designs are fit for the purpose for which they are intended.

The submissions shall be in accordance with the project programme.

The design submissions shall be in accordance with the design criteria submissions and shall include but not be limited to calculations, drawings and reports relevant to the Civil and Building Works to enable EirGrid conduct a comprehensive review of the designs.

3.2 ARCHITECTURE

The buildings shall be designed so that they are low maintenance and durable and can be operated safely. The architectural design and external finishes of the buildings shall generally conform with the architectural design of any adjacent buildings on the site, or otherwise as may be agreed with the Local Authority.

Regardless of the type of roof adopted for the substation (e.g. pitched, hipped etc), the station must incorporate a precast concrete or reinforced concrete flat roof to ensure security.

The overall design and selection of materials and finishes shall be compatible with the local receiving environment and shall be resistant to damage or deterioration due to such factors as water ingress, saltwater corrosion, wind damage etc. All materials and equipment shall be designed to withstand the most severe weather conditions anticipated at the site.

Exterior walls adjacent to hardstanding areas shall be resistant to damage by vehicular traffic, or otherwise protected by provision of approved bollards, barriers or similar devices. Any rendered external walls shall be finished in a self coloured render.

The buildings shall be of sufficient size to accommodate safely the scheduled electrical equipment including safe circulation, maintenance access and adequately sized access routes to accommodate replacement equipment.

A suggested layout of these spaces is shown on the drawings issued with this suite of specifications. These shall be used as a guide only, the minimum criteria being the safe accommodation of the scheduled equipment and fittings.

Where referenced in this specification the term “Customer’s Designer” means the Chartered Civil / Structural Engineer or, where appropriate, the registered professional Architect responsible for carrying out the civil and structural design on behalf of the Customer.

3.3 LOADING

The loading on the structure shall comply with EN 1991-1-1, EN 1991-1-2, EN 1991-1-3, EN 1991-1-4, EN 1991-1-5, EN 1991-1-6, EN 1991-1-7, EN 1991-2 and EN 1991-3 and associated National Annexes.

The following are the minimum live loading requirements for the buildings:

Suspended steel floor over GIS cable pit:	15 kN/m ²
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GIS room floor:	15 kN/m ²
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Steelwork supports for GIS protection cabinets:	7.5 kN/m ²
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The general floor load in all other areas is to be taken as not less than:	10 kN/m ²
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The design loads shall be no less than those specified by the GIS Equipment supplier. Note that in some cases equipment suppliers specify temporary loads of 20 kN/m² applicable during installation of the Switchgear.

General / Control room raised access floor shall be a class A floor to IS EN 12825 designed for the following loadings:

Ultimate load capacity:	15 kN point load
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Working load:	5 kN point load
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3.4 FIRE

The building(s) shall be designed in accordance with Part B, Fire Safety, of the Technical Guidance Document of the Building Regulations 1997 as a purpose ‘Group 6 Building’ (Industrial). Limitation on travel distances for the building should follow the guidance set out for places of ‘Industrial High Risk’ outlined in Table 1.2 of the TGD. It is the responsibility of the Customer to provide a Fire Safety Certificate if required, to make the application and to forward the certificate to EirGrid before commencement of the

Works. In the event of a Fire Safety Certificate not being sought, a letter of confirmation of this fact shall be forwarded to EirGrid stating the reasons why the development is exempt. Should a Fire Safety Cert not be required, a report on compliance should then be forwarded to EirGrid.

In addition to any requirements of TGD B, the minimum fire rating for the building shall be 1 hour, or higher if required by the Fire Safety Certificate.

All fire seals shall be certified as having a 1 hour rating, or higher if required by the Fire Safety Certificate, by an approved installer. They shall be tagged as such and listed in the Safety File.

3.5 DISABILITY ACCESS CERTIFICATE

Each substation shall require a Disability Access Certificate (DAC) from the Local Authority in accordance with the Building Control Regulations, SI 351 of 2009. However, given the proposed use of the developments, the Customer may request and be granted a dispensation from Part M, Access and Use, of the Building Regulations from the relevant Local Authority. The Customer shall submit confirmation of the grant of a Part M dispensation to EirGrid before commencement of detail design.

3.6 SITE SELECTION

The Customer's attention is drawn to the importance of selecting the optimum location based on a variety of criteria including:

- Available area;
- Topography (sloping or flat site);
- Flood risk;
- Streams, Rivers, Watercourses
- Geological and geotechnical characteristics of the soil;
- Susceptibility of site to landslides;
- Vehicle access;
- Environmental conditions;
- Pollution / Landfill;
- Altitude;
- Line corridors;
- Wayleaves.

EirGrid retains the right to determine the final site to ensure that any new transmission assets are sited in a planned manner in terms of the overall Transmission System.

3.7 SOIL INVESTIGATION

The Customer shall conduct an assessment of the ground conditions pertaining to the site by carrying out a full site investigation in accordance with EN 1997-1 & 2 and BS 1377 using a competent soils investigation contractor. The investigations shall include an interpretative report by a Chartered Engineer with a post-graduate degree in Geotechnical Engineering as a minimum qualification. The objectives of the investigation should be to confirm the suitability of the site, to enable the design to be prepared, to plan the optimum method of construction and to assess the level of contamination, if any, on the site. The investigation shall include a ground penetrating radar survey where there is evidence of existing services. The investigation should include soakaway tests where mains drainage is not available.

Soil resistivity shall be tested and taken into consideration with respect to the earth grid design as per EirGrid functional specification XDS-GFS-12-001.

For sites where the likelihood of landslide exists, the geotechnical investigations shall establish all geotechnical parameters required to carry out relevant calculations to determine the likelihood of such conditions occurring and for designing mitigation measures to prevent their occurrence.

In areas where there is evidence of karstified rock, in addition to borehole and other investigations, a suitable geophysical survey shall be carried out to determine locations of possible voids in the underlying rock.

If contaminated material or material requiring special disposal measures is encountered during excavations, the Customer shall dispose of this material in a manner appropriate to the material in accordance with all statutory and other requirements.

A copy of the final Soils Investigation Report shall be made available to EirGrid.

3.8 PLANNING, DESIGN AND CONSTRUCTION SUBMISSIONS

The Customer shall be responsible for the detailed design, strength and safety of the substation and compound to meet the structural, dynamic and environmental requirements.

3.8.1 PLANNING PERMISSION

The Customer shall submit a full set of planning submission documents for EirGrid review.

This will include but not be limited to the following studies where appropriate:

- Site Assessments (for wastewater treatment systems)
- Soakaway tests
- Flood studies
- Traffic studies

- Fire Safety Certificate Documentation
- Disability Access Certificate Documentation
- Appropriate Assessment Screening
- Noise Reports
- EIA, if appropriate

In general, the Customer will be responsible for submitting a request for planning permission, but only after prior agreement on the possible routes and sites with EirGrid. The Customer shall oversee the compliance with any conditions imposed by the relevant authority.

A copy of the proposed planning permission with attached conditions shall be submitted to EirGrid for review at least 4 weeks prior to lodgment of the planning application.

3.8.2 DESIGN AND CONSTRUCTION SUBMISSIONS

The Customer shall submit the documentation listed below for EirGrid review. All documentation submitted shall be quality controlled and be subject to internal verification by the Customer and the Customer's Designer prior to submission to EirGrid. Documents shall state the full names of the producer, verifier and approver of the document / drawing submitted.

- Soils Investigation Report at least 8 weeks prior to commencement on site;
- Flood Risk Assessment Report at least 8 weeks prior to commencement on site;
- Appropriate Assessment Screening Report at least 8 weeks prior to commencement on site;
- Full planning submission documents at least 4 weeks prior to date of submission;
- Fire certificate submission at least 4 weeks prior to submission;
- A document titled 'Design Criteria for Civil and Structural Works' summarising all design related parameters, at least 2 weeks prior to commencement of detailed design;
- A set of structural calculations and drawings at least 8 weeks prior to commencement of work on site. Note: drawings received without full calculations will be returned to the Customer.
- A Design Risk Assessment at least 6 weeks prior to commencement of work on site.
- A Ground Risk Register at least 6 weeks prior to commencement of work on site.
- A set of construction drawings, steelwork fabrication drawings and cladding / roofing drawings at least 3 weeks prior to commencement of work on site.

Notice of completion of civil works shall be given to EirGrid in writing two weeks before the expected issue date. Prior to completion all information stipulated in the Specification shall be supplied to EirGrid.

All documents necessary for upkeep and maintenance of the building and structures, including all required certificates confirming the suitability of materials used as covered by this Specification, shall be submitted by the Customer with the Safety File.

The Design Risk Assessment should cover all activities including Construction, Operation and Maintenance of the Station over its lifetime.

The DRA should identify whether any space within the Station can be classified as a confined space (per HSA Code of Practice for Working in Confined Spaces) once the electrical equipment is installed and mitigate the associated risks.

3.8.3 DESIGN CRITERIA DOCUMENT

Before commencing the actual design of the complex, the Customer shall produce a document titled 'Design Criteria for Civil and Structural Works', which shall outline in detail all design related parameters used, including standards, codes of practice, loadings, texts, design procedures, computer programmes, etc.

Notice of intention to issue practical completion to the appointed works contractor shall be given to EirGrid in writing 4 weeks before the expected issue date. Prior to issue of the Practical Completion Certificate the following information shall be supplied to EirGrid.

3.8.4 FIRE DOOR CERTIFICATES

The Customer shall submit the following documentation in relation to Fire Door Certificates:

- Architects/Engineers Certificates of Compliance (on standard forms e.g. published by RIAI) that the building has been constructed in accordance with the Building Control Act and the Building Regulations.
- Compliance, Test and Commissioning Certificates associated with electrical and mechanical works.

3.8.5 OTHER INVESTIGATIONS

The Customer shall also undertake all other deemed necessary investigations required to complete the design and make the reports of the investigations available to EirGrid. These investigations may include a buried services survey where the PSDP deems it necessary.

Where the project is in a peat area a geotechnical risk assessment shall be completed and a geotechnical risk register established. Other investigations shall include a Topographic Survey, an Environmental Soils Classification Report and a Site Assessment Report.

3.8.6 FLOOD RISK ASSESSMENT

The Customer shall also prepare a flood risk assessment report. The site selected shall be assessed for the 1000 year return event. The report shall be made available to EirGrid. No development shall be allowed for inside the 1 in 1000 year event floodplain of a river or watercourse and all planning applications should be accompanied by a Flood Risk Assessment (FRA) in accordance with statutory guidelines.

3.8.7 APPROPRIATE ASSESSMENT SCREENING REPORT

Where necessary, the Customer shall also prepare an Appropriate Assessment under Article 6(3) of the Habitats Directive of the implications of a plan or project, either individually or in combination with other plans and projects, on a Natura 2000 site in view of the site's conservation objectives.

3.9 DURABILITY

The Civil and Building works shall be designed for a minimum life of 50 years. All exposed steel shall have a minimum period to first maintenance of at least 20 years. Exposed steel shall not be used in battery rooms.

3.10 MATERIALS

All materials used shall be new and of high quality and be suitable for the environment in which they are installed. Materials and colour schemes not specified in this specification shall be subject to the acceptance of EirGrid.

3.10.1 CONCRETE MATERIALS

This part of the Specification shall be read in conjunction with IS EN 206, IS EN 1992 and IS EN 13670.

The Customer shall provide information, details and certificates as required in the various sections of the Specification including:

- Concrete Mix Report: The Customer shall at contract commencement submit to EirGrid a site-specific report titled 'Concrete Mixes' in accordance with requirements of this Specification.
- Inspection Sheets: Inspection and tolerance sheets included in Appendix A shall be completed by the Customer for all concrete works.

Certificates of compliance shall be provided for materials and products used in the Works. Products bearing the CE mark or third-party certification shall be checked against the delivery ticket and visually inspected.

3.10.1.1 CEMENT

Cementitious Material used in the Works shall be as defined in IS EN 197-1 and the Irish National Annex to IS EN 206.

The quantities of cement used shall be based on Table 1 of the 2011 revision of IS EN 197-1. Future revisions to the code will supersede the percentages currently listed in Table 1.

Cement shall be supplied from a single source to ensure uniformity of colour in the finished concrete.

Super-sulphated or high alumina cements shall not be used either in concrete or mortar.

CEM III cements shall not be used for elements with an XF exposure class.

Cements in combination with a type II addition in accordance with the Irish National Annex to IS EN 206 shall consist of the following:

- CEM I or CEM II cement to IS EN 197-1.
- A minimum of 30% type II additions shall be used in concrete with the following restrictions:
 - Electrical equipment bases are to have 0% type II additions.
 - Total percentage of fly ash is limited to 35% (the limit is based on the quantity of fly ash already in the cement as well as additional quantities).
 - Maximum limits as set out in IS EN 206.
 - Employer approval is required where the overall percentage of clinker (Ordinary Portland Cement) in the cement is less than 35%.

3.10.1.2 AGGREGATES

Aggregates shall comply with IS EN 12620 and shall consist of naturally occurring materials from a source approved by EirGrid and open to inspection.

The Customer shall obtain evidence from the producer of conformity with the Irish National Annex of IS EN 206 to ensure the aggregates in the concrete do not lead to alkali-silica reaction.

3.10.1.3 WATER

Water shall be in accordance with IS EN 1008.

3.10.1.4 ADMIXTURES

The use of admixtures, where permitted, shall be in accordance with IS EN 206 and IS EN 934-2.

If the Customer intends to use two or more admixtures in combination he shall consult the manufacturer(s) and verify that these proposals are acceptable.

3.10.1.5 PIGMENTS

Pigments shall be in accordance with IS EN 12878.

3.10.1.6 FORMWORK AND FALSEWORK

Certificates of compliance shall be provided for materials and products. Formwork and Falsework shall be in accordance with the requirements of BS 5975 and shall be designed to withstand the most onerous combination of applied loads from whatever source including dynamic effects from vibrating and compacting the concrete. Concrete pressures shall be derived in accordance with the requirements of BS 5975 and CIRIA Report No. 108: Concrete Pressure on Formwork.

Formwork spacers shall not impair the appearance or durability of the concrete structure.

Form release agents shall be to the approval of the Customer's Designer. They shall be applied carefully and sparingly and shall not be allowed to come in contact with concrete surfaces or with items (including reinforcement) which are to become bonded to the concrete.

Striking of formwork shall be subject to the permission of the Customer's Designer and shall be in accordance with IS EN 13670 and subject to an absolute minimum 5 MPa concrete strength to resist damage to surfaces that may arise during the striking.

3.10.1.7 REINFORCEMENT

Steel reinforcement for concrete shall be in accordance with IS EN 1992 as amended by the provisions of this clause.

Concrete reinforcing steel shall comply with IS EN 10080 in conjunction with the following standards:

- BS 4449 Steel for the reinforcement of concrete,
- BS 4482 Steel wire reinforcement,
- BS 4483 Steel fabric

Stainless steel reinforcing bars shall be in accordance with BS 6744.

Steel reinforcement shall be scheduled, cut and bent in accordance with BS 8666 and shall be obtained from a firm holding a valid certification from CARES [or fully equivalent scheme].

Support chairs for reinforcement shall be designed by the Customer in accordance with BS 7973-1.

To provide a continuous steel conductive path all reinforcement bars [i.e. in both faces] of floor slabs and walls shall be welded at crossover points at 3 m intervals prior to pouring concrete. 95 mm² copper conductor shall be bolted to reinforcement at designed intervals using Crosby clamps and connected to the earth grid. This clause only refers to concrete work in GIS buildings in higher voltage (110 / 220 / 400 kV) substations.

Earth tails shall be placed into concrete works and passed under shutters to be connected to the earth grid. Disks shall be placed on the soffits of slabs and inside walls to tie the earthing into the superstructure of the building.

Fibre reinforcement where used shall be in accordance with the manufacturer's instructions and the following standards.

- IS EN 14889-1 – Fibres for Concrete. Steel Fibres. Definitions, specifications & conformity
- IS EN 14889-2 – Fibres for Concrete. Polymer Fibres. Definitions, specifications & conformity
- IS EN 14845-1 – Test methods for fibres in concrete

3.10.2 CONCRETE FINISHES

All concrete surfaces shall be smooth and true. All fins which may occur between boards or panels shall be removed and air holes filled with mortar of approved composition and colour. Any area requiring treatment after stripping as outlined above shall afterwards be rubbed down with a carborundum block and washed perfectly clean. No surface treatment shall be carried out until the surface has been inspected by the Customer's Designer.

Finishes shall be in accordance with Table 3-10-1 – Concrete Finishes Schedule.

Finishes to formed surfaces shall in general be as follows:

a) Class F1- Rough finish for buried or rendered work

This finish is generally intended for surfaces against which backfill, further concrete or grout will be placed, including recesses for bolts and other built in parts or for surfaces which would otherwise be concealed from view. The surface shall be uniform, without honeycombing or sand runs and shall be free of surface defects.

b) Class F2- Normal finish of exposed work

This finish is required for structural surfaces permanently exposed to view, but where finish is not critical, such as walls of fire escape stairs or plant rooms or columns and beams to structures that are normally viewed in the shade, e.g. car parks and warehouses. The finish is intended to be left as struck; however, imperfections such as fins and surface discolouration shall be made good to the approval of the Customer's Designer.

c) Class F3-Superior finish for exposed work

This finish is required for surfaces permanently exposed to view such as prominent or important architectural features, or for precast concrete units. The surface shall be smooth and of uniform texture and appearance without staining, discolouration, boardmarks or surface pitting. Formwork shall be of the same type and obtained from only one source throughout any one structure. All surface blemishes shall be removed and/or filled to match the colour of the original concrete. Provision for internal ties and embedded metal formwork supports in the permanent works shall be permitted but shall be on a regular spacing.

d) Class F4-Enhanced superior finish for exposed work

This finish is required for buildings requiring only the highest standard of finish. This finish shall be obtained in the same way as Class F3 finish except that while the concrete is still green all surface blemishes shall be filled. Internal ties and embedded metal formwork supports shall not be allowed.

All formwork joints for all classes of finish except for Class F1 shall form a regular pattern with horizontal and vertical lines continuous throughout each structure and all construction joints shall coincide with these horizontal and vertical lines.

Unformed finished concrete surfaces shall be classified in accordance with the class listed below.

a) Class U1 - Unformed Finish ("Screeded")

This finish shall be required for the surface of foundations, bases, slabs and structural units to be covered by backfill, subsequent stages of construction, bonded concrete toppings or mortar beds, and also for exposed surfaces of paving where a superior finish is not required and as the first stage for finishes U2 or U3.

It shall be obtained by levelling and screeding the concrete to produce an even, uniform, plain or slightly ridged surface without laitance; surplus concrete shall be struck off by a straight edge immediately after compaction.

b) Class U2 - Unformed Finish ("Floated")

This finish shall be required for the surface of beds and slabs intended to receive further finishes or for exposed surfaces where a steel-trowelled finish is not required. Floating shall be done only after the concrete has hardened sufficiently and shall not be continued to the extent of bringing excessive fine material to the surface, but only so as to produce a uniform surface free from screed marks, and within any tolerance stated or implied for the thickness of bedding or bonding material.

c) Class U3 - Unformed Finish ("Steel Trowelled")

This is a hard smooth finish which shall be required for surfaces of high quality concrete floors and pavings, tops of wall copings, tops of bases to directly receive steelwork, unformed surfaces of architectural features (including precast units), for surfaces of beds and slabs to receive thin flexible sheet and tile pavings bedded in adhesive, and seatings for metal items where the metal is in

direct contact with the concrete. Trowelling shall not commence until the moisture film has disappeared and the concrete is sufficiently hard to prevent the working of excess laitance to the surface. The surface shall be trowelled firmly and left free from trowel marks.

Class U3 finish may be produced by power floating of concrete subject to the requirement that such work is carried out by experienced and skilled workmen.

d) Class U4 - Brushed Finish

This is a textured finish with average depth of 1mm, obtained by producing a floated finish and then drawing a wire broom over the concrete surface at right angles to the flow of traffic.

Description	Formed Surface	Unformed Surface
General Electrical Equipment Bases	F1 (Chamfer F2)	U3
Capped Bases, e.g. gantry and busbar bases	F1	U2
Transformer bund walls	F2	U3
Transformer bund Floor	-	U2
Transformer plinth	F2	U3
Transformer fire walls	F2	U2
Block Surface Ducts	-	U3
Retaining walls	F1 – Earth retaining face F2 – Visible face	U2
Non Retaining Boundary Walls	F2 – Visible face F1 (if face to be stone clad)	U2
Footing of retaining/boundary walls	F1	U2
Concrete compound roads, paths and ramps	F1	U4
Building foundations	F1	U1
Cable pit floor	F1 – Buried face F2 – Visible face	U2
Cable pit walls	F2	-

Description	Formed Surface	Unformed Surface
Control room sub floor	-	U2
Floors at finished floor level	-	U3 (power float)
Exposed soffit of suspended slabs	F2	-
Internal Walls above Cable pit Level	F3	-
Precast Concrete Elements	F3	U3

Table 3.10-1: Concrete Finishes Schedule**3.10.3 PRODUCTION OF CONCRETE**

Concrete specification, performance, production and conformity shall be in accordance with the requirements of IS EN 206. Notwithstanding this requirement, all structural concrete which is continuously under water shall have a minimum cement content of 325 kg/m³ and a maximum water cement ratio of 0.55.

The Customer shall produce a site specific report titled "Concrete Mixes" which shall detail his proposed concrete mixes for the project. This report shall include details of tests conducted (including chemical), analysis of results to confirm site / soil environment and shall demonstrate full compliance with the requirements of the approved codes and with the structural design. This report, which shall also include results of trial mixes / testing, shall be submitted for the approval of the Customer's Designer at least 28 days in advance of commencement of concrete works.

The Customer shall procure concrete only from producers that have had their production control procedures certified by an approved certification body in accordance with the provisions of Annex C of IS EN 206. In addition, the Customer shall provide, through the producer, a 'Declaration of Conformity' in accordance with IS EN 206 for all concrete produced.

Details of the quality control procedures in operation at the producer's works shall be submitted to the Customer's Designer for approval and facilities shall be provided there for him to inspect the batching and mixing of the concrete and materials used. Samples of materials shall be provided for any tests which the Customer's Designer may wish to carry out. Any inspection or testing carried out shall not relieve the Customer of his obligation to provide concrete fully in accordance with this Specification.

3.10.4 TRANSPORTATION AND ACCEPTANCE OF CONCRETE

The Customer shall plan the route to the Site in advance of any deliveries and shall consult with the Customer's Designer if any ambient conditions such as high or low temperatures, traffic congestion, etc. are likely to affect the quality of the concrete as

delivered. Where the period from batching to placing is deemed unacceptable by the Customer's Designer, the use of admixtures may be permitted, subject to the approval of the Customer's Designer. Only admixtures with a proven documented track record of use with the particular design mix proposed will be accepted. Dry batching or the addition of water in the truck shall not be permitted.

Concrete shall be placed and compacted with minimum delay after mixing and shall be compacted and in its final position within 1 hour of the introduction of cement to the aggregate unless a longer time is agreed by the Customer's Designer. The addition of water and admixtures to the concrete in the truck is forbidden.

3.10.5 PLACING OF CONCRETE

No concrete shall be placed until the site of placing (including forms, reinforcement, and embedded items) has been inspected and, if possible, approved by the Customer's Designer and adequate notice shall be given to enable the Customer's Designer to attend all tests, inspections, checks, etc. as may be necessary. To facilitate this, the 'pre-concreting' section of the concrete inspection sheet (see Appendix A) shall be completed by the Customer at least 4 hours before the placing of any concrete. All relevant items shall be checked, agreed and signed off by the Customer.

Placing and compaction of concrete shall only be carried out under supervision of suitably qualified personnel. Control procedures shall be established to cover all aspects of workmanship including placing, compacting, finishing, curing, hot and cold weather concreting, large concrete pours, underwater concreting, etc.

Curing shall be in accordance with IS EN 13670. Curing and protection shall start immediately after the compaction of the concrete. The Customer shall submit his curing proposals for the Customer's Designer's approval before work commences.

Construction and movement joints shall be in accordance with the requirements of IS EN 1992-1-1, IS EN 1992-3 (for water retaining structures) and IS EN 13670.

Aggregates and mixing water shall be free from snow, ice and frost.

All surfaces with which the fresh concrete will come into contact are to be free from snow, ice and frost and preferably be at a temperature close to that of the fresh concrete. Water curing shall not be applied in conditions where freezing of concrete is anticipated. This shall apply regardless of the air temperature at the point of placing.

The minimum concrete temperature at the time of placing shall be 10°C. The temperature of the concrete should, at no point, fall below 5° until the concrete in the structural element reaches a strength of 5 N/mm².

Concrete shall not be placed while the air temperature is below 2°C measured on a rising thermometer or below 4°C measured on a falling thermometer.

Any concrete damaged by freezing shall be removed from the Works. Concrete shall not be allowed to come into contact with water at a temperature greater than 60°C.

Concreting in hot weather shall be in accordance with IS EN 13670.

3.10.6 SAMPLING AND TESTING OF CONCRETE

Samples (a minimum of 10% of deliveries or higher if requested by EirGrid) for identity testing, shall be taken from the point of discharge of the concrete into the works by the standard method of sampling as defined in EN 12350-2.

Samples for identity testing, shall be taken from the point of discharge of the concrete into the works or as otherwise directed by the Customer's Designer by the standard method of sampling as defined in EN 12350-1. Each set of specimens shall be accompanied by a certificate of sampling and manufacture as required by IS EN 206. Testing shall only be carried out by an independent testing laboratory approved by the Customer's Designer which is fully accredited to IS EN ISO/IEC 17025 by an approved accreditation agency such as INAB or UKAS.

Results of laboratory testing shall be sent independently by the laboratory to the Customer's Designer.

The following tests should be performed and results submitted directly to the Customer's Designer:

- Compressive Strength Testing in accordance with IS EN 206-1
- Consistence (slump) Testing

The Customer shall ensure by proper supervision, execution and inspection that the Works are completed in accordance with the Specification.

The Customer shall complete the forms in Appendix A for all concrete works. This contains separate inspection requirements for:

- Inspection of pre-concreting operations
- Delivery records / Inspection of fresh concrete
- Inspection of placing and compaction
- Inspection of post-concreting operations

Where non-conformity is confirmed, the measures necessary to make the component acceptable or the necessity of rejection and replacement will be the responsibility of the Customer's Designer.

3.10.7 PRECAST AND PRESTRESSED CONCRETE

Precast and prestressed concrete structural elements shall be in accordance with the requirements of IS EN 1992 [or IS 326 until withdrawn] and IS EN 206-1.

Precast concrete units shall be handled and erected in accordance with IS EN 1992 [or IS 326 until withdrawn] and IS EN 13670.

The Customer shall carry out a reception inspection of pre-cast units. Where non-conformity on site is confirmed, the measures necessary to make the component

acceptable or the necessity of rejection and replacement will be decided by the Customer's Designer.

Note that all pre-cast concrete roof elements with hollow cores shall have pre-drilled 20 mm holes on the soffit in each core at 250 mm from each support. Alternative systems without cores should be considered where possible.

3.10.8 ANCILLARY CONCRETE ITEMS

3.10.8.1 HOLDING DOWN ANCHOR BOLTS

The combination of bolt, nut and washer for pre-loaded bolted assemblies shall be to the requirements of IS EN 14399 Part 4 & 8.

Threads for holding down bolts shall be protected with 'Densotape' or similar approved material by the Customer's Designer during delivery storage and during / following concreting (associated nuts and washers shall be similarly protected during / after concreting).

Bolts sleeves (when used for foundation anchors) shall be mild steel and shall not allow the passage of cement grout into the tube.

After concreting, the bolt projections with attached nuts and washers shall be protected against corrosion with sealing tape and protected against mechanical damage until the erection of the steel works or other plant or fixtures commences.

Holding down bolts and holding down bolt assemblies shall be located in the position shown on the Customer's Designer's drawings. Bolts shall be located in accordance with the requirements of IS EN 1090. The position of the centre of any bolt shall not vary by more than +3 mm from its specified position for bolts cast rigidly and + 10 mm for bolts cast in sleeves. The position of the other end of the bolt shall be set such that the slope of the bolt can be accommodated by the clearance provided in the boltholes. The projection of the end of the bolt shall not deviate from that specified in the project specification by more than the following:

- For bolts set vertically +10 mm or – 5 mm
- For bolts set horizontally + 45 mm or – 5 mm

3.10.8.2 DOWEL BARS

Dowel bars shall be straight round smooth mild steel bars complying with BS 4449. The free end shall be sawn and free from burrs or other irregularities. Bond breaking at expansion or contraction joints may be achieved by means of dowel sheaths. The sheathed end of the dowel bar shall be cast in first. Caps shall be securely fixed and shall permit free movement of one end of the bar.

Dowel adhesive shall be provided by an approved supplier and installed in accordance with the manufacturer's instructions.

Pull out testing of dowels shall be carried out at a frequency of 1 in 10 dowels subject to

a minimum of 1 as agreed with the Customer's Designer.

3.10.8.3 GROUTING WORKS

Grouting of baseplates to structural steel and plant shall be carried out using proprietary high strength non-shrink high flow cementitious grout.

Transport, handling, storage, placing and curing of the grout shall be in accordance with the producer's instructions.

Testing of grout shall be carried out in accordance with IS EN 1219 by carrying out bulk density and 7 day compressive testing on 40 mm x 40 mm x 160 mm prisms of grout.

3.10.8.4 POST FIXED ANCHORS

Where the Customer proposes the use of post fix anchors, they shall be designed in accordance with "Concrete Advice No. 5" published by The Concrete Society in the United Kingdom. Reference shall also be made to the "Code of Practice for the Design and Installation of Anchors" published by the HAS. Sample forms FM-02 and FM-03 to be used in the design are included in this document.

Anchors (including post drilled reinforcement) are not permitted to support key structural elements such as floors, beams, walls, roofs, columns, stairs etc. unless specified otherwise by the Customer's Designer.

Unless otherwise specified, bolts and nuts forming part of the anchor system shall be Grade 8.8 in accordance with BS 3692 and BS 4190.

The Customer's Designer shall assume that the concrete is "cracked" for design purposes.

Unless specified otherwise by the Customer's Designer, all anchors shall be considered to be safety critical.

The selection and installation of anchors shall be in accordance with the Construction Fixings Association (CFA) guidance note 'Anchor Selection' and 'Anchor Installation' and the anchor manufacturer's recommendations.

Post fixed anchors shall not be installed prior to the completion of the 28 days curing time of the concrete.

The selected anchor system shall have a corrosion protection treatment sufficient to give a working life of at least 50 years for the atmospheric exposure condition pertaining to the location of the installation. Minimum corrosion treatment shall be hot dip spun galvanised in accordance with IS EN ISO 1461, BS 7371-Part 6 and IS EN 13811 as applicable.

Unless otherwise specified, a minimum of 1 in every 4 (25%) of the installed anchors shall be proof load tested by a UKAS accredited testing company in accordance with the CFA guidance note 'Procedure for Site Testing of Construction Fixings'. The test Proof Load shall be 1.75 times the Manufacturers Recommended Load for the fixing.

3.10.9 ROADWORK MATERIALS AND TESTING

Roadworks shall be constructed using the materials specified in clause 4.16 of this Specification.

Road work materials shall be tested for following:

- Granular Material Type B - A particle size distribution and Los Angeles Coefficient as specified in EN 1097-2:1998 Cl 5 shall be submitted prior to delivery of material on site and for each subsequent 300 tonne of material delivered to site. See section 4.1.2 for restrictions on Sulphur content in regard to the prevention of pyrite induced expansion.
- Pavement & Footpath Concrete- Testing of pavement and footway concrete shall be in accordance with the requirements of Section 6 of this specification and in accordance with Clause 1004*.
- Bituminous Materials -The testing of bituminous bound materials shall be in accordance with series 900*.

Testing of Sub-Base

Plate load testing / CBR testing in accordance this specification shall be carried out on the Clause 804 sub-base at a frequency of one per 50 m, subject to the length of road to be tested or as agreed by the Customer's Designer.

3.11 DOCUMENTATION

All documentation for submission to EirGrid for review as listed in this specification shall be submitted in duplicate, and all drawings shall be in CAD format. The relevant CAD format shall be clarified with EirGrid. All as-built drawings and operation manuals shall be submitted in duplicate to EirGrid upon completion of the Civil and Building works in accordance with the agreed project schedule. Both hard and soft copies of all information required to be submitted.

3.12 INSPECTIONS BY EIRGRID

Inspection of the construction works will be carried out on an ongoing basis by EirGrid. The following, which are considered key elements of construction, may be inspected:

- Setting out of building in accordance with planning permission
- Earth grid installation
- Formation level of foundations
- Foundation / cable pit construction
- Buried cable ducts and testing
- Concrete works

- Structural steelwork construction
- Installation of roofing system
- Cladding construction
- Building superstructure to be weatherproof on completion
- Transformer bay bunds to be tested successfully on completion
- Drainage to be tested successfully on completion
- Roads
- Fencing panels to be approved before erection and the first panel shall be erected and approved prior to the rest of the fence being erected
- Compound stone – samples to be approved prior to stoning

At project inception, a schedule of construction inspection points will be agreed between the Customer and EirGrid. EirGrid shall be contacted by the Customer at least 2 weeks in advance of agreed inspection point dates at which point EirGrid will confirm whether or not an inspection will be carried out.

Following any inspection the Customer shall remedy any defects advised by EirGrid. If the work is not to the specified standard, EirGrid will not take it over.

3.13 WARRANTY

The civil and building works shall be fit for their intended purpose and shall be free from any defects in design materials and or workmanship. The Customer shall provide EirGrid with a written warranty and representation that the civil and building works are fit for their intended purpose and are free from any defects in design materials and or workmanship. The Customer shall also provide a collateral warranty, with ESB Networks named as a beneficiary, of six (6) years duration covering all the works.

3.14 QUALITY ASSURANCE

3.14.1 CONCRETE CONSTRUCTION RECORDS

Construction records for the preparation, pouring and curing of concrete structures shall be kept available for audit. A sample form is included in Appendix A of this Civil Works Specification.

3.14.2 TOLERANCES

Construction tolerances are as specified in this Civil Works Specification. Tolerance checks on slabs and plinths shall be recorded and kept available for audit. Sample

record forms for electrical equipment and transformer plinths are included in Appendix A of this Civil Works Specification.

3.14.3 BUND TESTING RECORDS

Bunds shall be tested and the bund test results recorded in accordance with the concrete specification in this Civil Works Specification. Notwithstanding compliance with the test requirements, if leakage is visible external to the bund it will be deemed to have failed. A sample form is included in Appendix A to Civil Works Specification.

3.14.4 DUCT PROVING RECORDS

Ducts shall be tested and the duct test results recorded. A sample form is included in Appendix A of this Civil Works Specification.

3.14.5 MASONRY DUCT SIGN-OFF

Masonry ducts shall be signed off by the Customer. A sample form is included in Appendix A of this Civil Works Specification.

3.14.6 SERVICES AS-CONSTRUCTED RECORDS

As-Constructed records of services laid shall be as per the relevant sections of this Civil Works Specification.

4 AIS AND GIS SUBSTATION WORKS

4.1 SITE PREPARATION COMPOUND WORKS AND RETAINING WALLS

The Customer shall be responsible for all site preparation including but not limited to the substation compound area and clearance of vegetation, rubbish, foreign materials etc. prior to the commencement of scrubbing and grading of the site to accommodate the proposed structure and compound levels. Allowance shall be made for grading banks where necessary.

The earth grid design shall be complete in advance of the compound design. An allowance for HDPE ducting for earth grid shall be made at service and road crossing points where a clash may occur due to relative levels.

All rooms in the substation buildings shall be located a minimum of 150 mm above the surrounding ground. However, level access must be provided at all entrances / doorways in accordance with TGD Part M. All entrances / doorways shall incorporate a drainage channel such as an Aco-drain or similar approved.

The surface level of all roads and electrical equipment bases and duct covers shall be 50 mm above the compound stone level.

The compound works shall include grading, excavation of unsuitable material, hauling, dumping, spreading and compaction of the entire yard area, as well as the building of retaining walls necessary to ensure that the substation yard is established as a stable platform suitable for accommodating the substation switchgear and buildings.

Hardstanding areas and roads shall be constructed in accordance with the requirements of National Roads Authority (NRA) Specification for Road Works and in accordance with this Specification.

Note that although the NRA was subsumed into Transport Infrastructure Ireland (TII) through a merger of the NRA and the Railway Procurement Agency (RPA) under the Roads Act 2015, with effect from 01/08/15, the Specification for Road Works was an NRA document at the time of the current revision of this Specification. In the event of future revisions to the text of NRA documents, current references to the NRA will be superseded by the equivalent TII document.

The over site preparation for the hardstanding shall be based on the Soils Investigation Report.

A compound design drawing, clearly indicating the terrace levels, slopes and drainage arrangements shall be submitted to EirGrid for review prior to commencement of site works. Refer to the project deliverables listed in section 3.8.2 of this Specification for the time of submission.

4.1.1 SUITABLE AND UNSUITABLE MATERIAL

The Customer shall employ only plant and working methods which are suited to the materials to be handled and traversed. They shall be responsible for maintaining the

nature of all fill material so that when it is placed and compacted it remains acceptable in accordance with the Contract. Acceptability shall be determined in accordance with Tables 6/1 and 6/2 of the NRA 'Specification for Road Works'.

"Suitable Material" shall comprise all that which is acceptable in accordance with the Contract for use in the Works other than landscape areas and earth bunds. "Suitable Material" shall be Granular material Class 6B, 6F1, 6F2 and Clause 804.

"Unsuitable Material" shall mean material other than suitable material. Unsuitable Material, if approved by EirGrid, may be incorporated in landscape areas and earth mounds. Unsuitable material shall include:-

- Material which does not comply with the permitted constituents and material properties of Table 6/1 and Appendix 6/1, of the NRA Specification for Road Works,
- Pyrites
- Material from swamps, marshes or bogs;
- Peat, logs, stumps and perishable material,
- Material susceptible to spontaneous combustion,
- Material in a frozen condition,
- Clay of liquid limit exceeding 80 and/or plasticity index exceeding 55, materials having a moisture content greater than the maximum permitted for such materials in the Contract,
- Silts defined for the purposes of this contract as uniformly graded material having a uniformity co-efficient of 10 or less and containing 80% or more in the particle size range 0.06 - 0.002 mm and having a moisture content greater than the optimum moisture content of the material,
- Material having hazardous chemical or physical properties requiring special measures for its excavation, handling, storing, transportation, deposition and disposal.
- Non-argillaceous material

All unacceptable material as defined above and not required to be processed or used in the works, shall, unless EirGrid permits otherwise, be disposed of in accordance with applicable regulations and enactments by the Customer. Any material taken offsite for disposal shall be disposed of in a licensed tip only. The Customer shall submit details of the licensed tip to EirGrid for acceptance prior to removing any material off site.

4.1.2 PYRITE INDUCED EXPANSION

The Customer shall provide certification from the quarry or fill material supplier to show that all granular fill material for use under or within 500 mm of structures (including electrical equipment bases, concrete roadways, footpaths, floor slabs and transformer

bunds) has a total sulphur content not exceeding 0.4% by mass as determined in accordance with EN 1744-1, clause 11.

4.1.3 CONSTRUCTION OF FILL MATERIAL

Fill material shall generally be granular material and shall be as specified on the drawing and shall be one of the following:

- Class 6B material for use as a starter layer in poor ground. Material shall be in accordance with Tables 6/1 and 6/2 of the NRA Specification for Road Works.
- Class 6F1 material for use as a capping layer. Material shall be in accordance with Tables 6/1 and 6/2 of the NRA Specification for Road Works.
- Class 6F2 material for use as a capping layer. Material shall be in accordance with Tables 6/1 and 6/2 of the NRA Specification for Road Works.
- Clause 804 granular material for use as a structural fill.

The Customer shall construct all fills, including embankments as follows:

- By depositing, as soon as practicable after excavation, in layers to meet the compaction requirements of Clause 612 of the NRA Specification.
- With a maximum gradient of 1 vertical to 2 horizontal Earth moving plant shall not be accepted as compaction equipment.
- Starter layer fill shall not be deposited in layers greater than 600 mm uncompacted. It shall be compacted in accordance with method compaction, Method 5 as set out in Table 6/4 of the NRA Specification for Road Works using plant appropriate to the Class of fill and the site conditions.
- Capping material shall not be deposited in layers greater than 250 mm uncompacted. It shall be compacted in accordance with method compaction, Method 6 as set out in Table 6/4 of the NRA Specification for Road Works using plant appropriate to the Class of fill and the site conditions.
- Structural fill [Clause 804 material] should not be deposited in layers exceeding 225 mm uncompacted. It shall be compacted in accordance with Table 8/1 of the NRA Specification.
- During construction of embankments and other fills, exposed fill material shall be protected against scour and erosion from any source.
- The use of lightweight fill as a permanent fill material is not acceptable.

Soft spots shall be excavated for all material with a CBR of less than 15%.

4.2 PILING

The Customer's Designer shall make their own assessment of the ground conditions and make whatever specific site investigations including drillings and testing they consider necessary to guarantee the performance of the piles.

Piles shall be designed to safely support a minimum of two and a half times the specified working load in all cases.

The Customer shall submit to EirGrid for review, design calculations, including settlement calculations to meet specified acceptable settlement (including differential settlement) tolerances supplied by machine / equipment manufacturers, and drawings for proposed piled foundations at least three weeks before commencement on site. The calculations shall also specify the acceptance criteria for test piles and consider action of pile groups (if applicable).

Piling shall be designed, installed and tested in accordance with IS EN 1997-1 and the "ICE Specification for Piling and Embedded Retaining Walls" published by the Institution of Civil Engineers, London, (latest edition) hereinafter referred to as the ICE Specification and such other Euro-norms as may apply (including EN1536 for bored piles, EN 12699 for displacement piling, EN 12754 for precast concrete piles, etc) or other approved equivalent standard.

No working pile shall be installed before preliminary pile testing has been successfully completed and the adequacy of the proposed pile design demonstrated to the satisfaction of EirGrid. The Customer's programme shall include sufficient time set aside for construction and testing of preliminary piles to reflect this requirement.

The following tests shall be carried out on working piles:

- Maintained Load Testing of working piles
- Additional suite of maintained load testing of non-working piles, uplift, etc
- Integrity Testing of All Cast-in-Place Working Piles

The Customer shall ensure that during the course of the work, displacement or damage which would impair either performance or durability does not occur to completed piles.

Piles shall not be bored so close to other piles, which have recently been cast and which contain workable or unset concrete, that a flow of concrete could be induced from or damage caused to any of the piles.

Reinforcement left protruding above pile cut off level shall be protected by wrapping in denso tape and surrounding in lean mix concrete.

Note that the Customer's Piling Designer is defined as a Designer and potentially a Temporary Works Designer in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 2013 and will be required to discharge his duties in accordance with the Regulations, including the completion and submission of permanent and temporary works design certificates.

4.3 COMPOUND STONING AND GRAVEL FILLING

The unpaved areas within the substation compound plus 1m outside the fencing must be finished with a minimum 150 mm layer of 50 mm single sized crushed limestone.

The grading requirements for the compound stoning are as follows:

- 100% passing a 60 mm sieve.
- 85 - 100% passing a 50 mm sieve.
- 0% passing a 40 mm sieve.

The compound stone shall be separated from the subsoil / capping layer by a suitable approved geotextile membrane heat bonded continuous filament.

The Customer shall ensure that a capping layer or additional stoning is provided based on the outcome of the design requirements in order to prevent rutting of the compound stone by maintenance vehicular access. The capping layer shall comprise capping material 6F1 or 6F2 (but not crushed concrete). If required in poor ground conditions a starter layer of 6B material shall be placed and compacted beneath the capping layer. Compaction of capping material shall be in accordance with Methods 5 and 6 of Table 6/4 of the NRA Specification for Roadworks. The stoning levels should be uniform throughout the site.

No unprotected sub-formation which is to receive capping shall remain continuously exposed to rain causing degradation nor, unless permitted by the Engineer, be left uncovered overnight.

A sample of the stone shall be submitted to EirGrid for review prior to stoning the site and the following documentation submitted with the sample:

- Evidence based on testing that the material is limestone
- Particle size distribution

The finished stone level generally shall be 50 mm below the level of bases and duct covers.

4.4 COMPOUND DRAINAGE

The surface water drainage network shall be designed so that no flooding or surcharging of the network occurs for all rainfall events with a 30 year return period, and properties are protected against flooding for all rainfall events with a 100 year rainfall return period. Supporting calculations shall be submitted for approval prior to construction.

Allowance for climate change shall be incorporated in the rainfall data used in surface water drainage calculations.

Where applicable, source control disposal of surface water shall be designed in accordance with BRE Digest 365 and submitted for approval.

Erosion control and sediment management plans shall be drawn up and implemented for the management of surface water during construction.

Where construction works are within or adjacent to or otherwise impact upon an existing watercourse, the relevant statutory authorities shall be notified and consulted. Such works can only proceed subject to approval from the relevant authority.

Design and construction of all drainage shall be in accordance with IS EN 752, IS EN 12056 and the requirements of the Local Authority and all drainage construction works shall be carried out in accordance with the approved planning documents and any conditions specified by the planning authority.

The drainage system shall be designed to operate by gravity without pumps and shall only provide for pumping if absolutely necessary.

Drainage design shall follow industry best practice in accordance with Irish planning guidelines and policy documents. Relevant industry design manuals from the Construction Industry Research and Information Association (CIRIA) shall be followed and referenced in the design justification and calculations.

Roof drainage and drainage internal to buildings shall be in accordance with IS EN 12056.

Surface water drainage [including roof drainage] shall be designed using the appropriate meteorological rainfall data for the site location subject to a minimum design rainfall intensity of 75 mm/hour.

SUDS (Sustainable Drainage Systems) shall be used where practicable. The Customer is responsible for any permits required to connect to the public drainage system. They should also confirm its adequacy during the above rainfall event. If the public drainage system is not adequate, or if there is no suitable public drainage system to connect into, the Customer should design and incorporate suitable storage / attenuation into the drainage design.

Gradients shall be adequate to achieve the required minimum flow velocities for self-cleansing.

The storm water drainage system shall use uPVC pipes with a minimum diameter of 150 mm. All vertical storm water pipes shall be provided with rodding eyes at the base of all runs and at all branches and junctions.

4.4.1 OIL / WATER SEPARATING SYSTEMS

Oil interceptors shall be provided in the areas of the site where contamination due to oil is possible. A full retention class 1 separator is required to accept the discharge from all bunds; other run off can be passed through a bypass separator. Oil interceptors shall be constructed, inspected and tested as described in IS EN 858 and shall be accessible for maintenance.

Oil / Water separating pump systems, which remove water while leaving behind oil and contaminants, shall be fitted in a minimum 500 mm x 500 mm x 500 mm deep sump in all external transformer bunds as directed.

The system shall be an approved oil sensitive bund dewatering system with a 1 l/s low shear vortex pump with oil separation detection with an approved bund interceptor class 1 full retention oil separator with independent certification of compliance with IS EN 858.

The submersible pump shall be a single phase 230 V stainless steel submersible pump, capable of pumping 1.5 litres per second at a head of 3m, unless a greater flow rate or head is required for the particular installation.

The system shall be supplied, installed and fully commissioned before handover. A full maintenance check shall be carried out immediately before handover.

All pipes and drains laid shall be surveyed in situ after laying. The survey information shall be presented on an AutoCAD drawing referenced to the ITM Grid. Topographical information such as levels and contour lines, bases for electrical equipment, drainage, roadways, buildings, fences, associated notes etc shall all be drawn on different layers allowing the user to switch off different features for clarity. Cover levels and invert levels shall be clearly shown adjacent to manholes. All drainage and relevant non-drainage features shall be clearly marked on the drawing.

Foul water drainage shall be connected to the public sewerage system where available. The Customer is responsible for any permits required to connect to the public sewerage system. If there is not a suitable public sewerage system to connect into, the Customer shall supply a suitable foul water treatment unit in accordance with local environmental regulations and or planning permission.

4.4.2 RAINWATER GOODS

Gutters, downpipes and fittings shall be in accordance with the following standards:

- Sheet metal rainwater goods IS EN 612
- Cast iron rainwater goods BS 460
- Unplasticised PVC rainwater goods IS EN 12200-1

All materials shall be checked for soundness before erection.

Gutters, downpipes and fittings shall be erected in accordance with IS EN 12056-5.

Downpipes shall generally be external to rooms housing electrical equipment unless there is a valid reason that they should be internal such as security.

During erection, care shall be taken to ensure that no damage is caused to existing buildings and structures.

Steel and iron shall have a proprietary protection against corrosion. Any protective coatings which may have been damaged before or during erection shall be made good immediately as instructed by the Customer's Designer.

All materials shall be inspected after installation and those parts of the work which will be concealed shall be tested before being finally enclosed in accordance with IS EN 12056-5.

4.4.3 WATER MAINS

Pipes shall be MOPVC (up to and including 200 mm), CPE/PVC alloys (up to and including 200 mm), Ductile Iron, MDPE or HPPE. All plastic water pipes shall be blue in colour.

MOPVC pipes shall conform to the UK Water Industry Specification No. 4-31-08 and manufacturers shall operate a quality system in compliance with BS 5750 Part 2 (IS EN 29002).

CPE/PVC alloy pressure pipes shall conform to BS PAS 27. All fittings should conform to this standard also.

Ductile iron pipes shall conform to Class K9 of IS EN 545. Ductile iron fittings shall be Class K9. All ductile iron pipework shall be coated internally with a material that is approved for contact with drinking water.

MDPE pipes should be of type PE-80, have an SDR rating of 11 and conform to IS EN 12201: Part 2.

HPPE pipes should be of type PE-100, have an SDR rating of 17 and conform to IS EN 12201: Part 2.

4.5 SECURITY FENCING AND GATE WORKS

All station compounds shall be surrounded by a min 2.6 m high galvanised and powder coated steel palisade fence.

The palisade fencing and gate shall be manufactured and assembled in accordance with Part 12 of BS 1722-12. Galvanising shall be in accordance with EN ISO 1461 and powder coating to be in accordance with BS 6497.

This fence should be self supporting and not require the use of stays for support.

This fence shall incorporate a double leaf lockable palisade vehicle access gate with an opening of 4900 mm between the posts, incorporating a separate lockable personnel gate.

Gates shall be constructed in accordance with the project specific gate drawing and shall provide a comparable degree of security to the adjacent fencing.

The top of the uppermost gate rail shall be level with the top palisade fencing rail.

The overall height of the gate, when fixed, shall not be less than the adjacent fence height.

The spacing of pales shall not be greater than that used on the fencing.

A cowl shall be fitted over the lock on personnel gates. The height to the underside of the cowl shall be 1155 mm.

All gate frame joints shall be continuously welded.

The gate locks shall be accessible from the outside. The substation fence shall be connected to the substation earth mat as per the EirGrid Earthing and Lightning Specification XDS-GFS-12-001.

A concrete plinth, 150 mm deep by 200 mm wide, consisting of grade C28/35 concrete shall be constructed for the full length of fence with pales embedded into the plinth. The maximum clear spacing between the pales or between pale and post shall be 50 mm.

Pales shall be triple pointed and sprayed and welded to rails in accordance with Cl. 5.1 of IS 1722-12 to withstand a load of 18 kN.

All fences and gates shall be earthed in accordance with the project specific requirements and the relevant earthing details / drawings.

A property boundary perimeter fence shall be provided. Refer Appendix D for details.

The Customer shall ensure that all fencing components are transported, delivered and stacked in such a manner as to avoid damage to coatings. Large scale touch-up of coatings on site is unsightly and to be avoided.

The Customer shall invite EirGrid, to inspect the first panel of fencing erected prior to proceeding with the remaining fence erection. The Customer shall give a minimum of 1 weeks notice of this event to EirGrid.

4.6 OUTDOOR SUBSTATION STRUCTURES

All outdoor substation structures shall be capable of supporting the loads exerted upon them by the substation equipment during the climatic conditions as well as the fault conditions listed in the EirGrid specifications. External metalwork shall be hot dip galvanized to IS EN ISO 1461.

4.6.1 FOUNDATION WORKS FOR SUBSTATION STRUCTURES

The design of the foundations shall take account of the ground conditions and the forces exerted by the structures. Steel reinforcement shall be provided where necessary. Limit State method of design and/or crack checks shall be used to calculate the reinforcement. A suitable bolting arrangement shall be provided to connect the equipment supporting structures to the foundation. Foundation tolerance shall be such that water does not collect on foundations and that shimming and grouting under electrical equipment bases are not necessary. Base concrete shall be class C30/37. All support structure edging shall have a chamfered finish and must not represent a tripping hazard. Design and construction of foundations shall be in accordance with IS EN 1997.

4.7 HV CABLE DUCTING

This part of the specification sets out the requirements for the supply and installation of ducts for High Voltage (HV) cables for substation projects.

The supply and installation of ducts and couplers for High Voltage (HV) cables shall be in accordance with the latest revision of the EirGrid Cables specifications.

All ducts and couplers for HV cables (110 kV and 220 kV) shall be supplied by the Customer. All ducts/couplers for use with HV cables shall satisfy the criteria given in the Table in Appendix E.

Cable ducts to HV plant shall be directly encased in the concrete plinth for each item of plant. On exiting, the duct shall be suitably located within the concrete plinth so as to minimise the length of exposed cable to the equipment. The Customer shall ensure that the cable is appropriately supported by means of metal cable tray along its exposed length to ensure secure support and to prevent damage.

Ducting routes exiting the site shall be coordinated with the fencing layout to avoid clashes between fence post foundations and cable ducts.

The utmost care shall be taken during handling, laying, backfilling and testing of ducts to prevent damage. The ducts shall not be stored in a place where they are likely to be in contact with surface water or any foreign matter, which could make its way into the ducts. When in storage, dust caps must be fitted to the ducts. The method of stacking shall be such to avoid distortion and the integrity of the ducts shall be maintained.

Duct Installation including joint bays and backfill / surround requirements shall be in line with the Cable Duct Installation Guidelines described in Appendix E of the Specification.

All ducts shall be tested and roped in accordance with Appendix E.

Recording of as laid information including requirements for horizontal and vertical accuracy shall be in accordance with Appendix E.

4.8 CABLE TRENCHES AND COVERS

Appropriate cable trenches shall be provided for routing of cables in the substation compound. They shall be constructed of reinforced concrete or of masonry on a reinforced concrete base.

Trenches shall be sized to hold current and future cables as required but they shall be a minimum of 400 mm wide internally. The trench shall have a longitudinal slope of 1 in 500. The lowest end of each trench shall be fitted with pipes suitable for drainage.

Covers in non-trafficked areas shall be reinforced and capable of taking a minimum of 5 kN/m². Covers in trafficked areas shall be designed for the load of vehicles reasonably expected to drive over them, typically a 5.0 tonne wheel load.

4.8.1 DUCT COVERS [NON TRAFFICKED AREAS]

External duct covers shall be hydraulically pressed, precast concrete duct covers, either 900 x 600 x 65 mm thick or 600 x 600 x 65 mm thick depending on the duct width, reinforced with A142 mesh in accordance with BS 4483 with 30 mm cover. The slabs shall meet, as a minimum, the requirements of IS EN 1339. However, concrete shall have a minimum compressive strength class C30/37.

The top of the duct covers shall have a non-slip mottled finish. One in every six slabs shall incorporate 2 no. stainless steel plain socket lifting inserts.

After cutting, any exposed reinforcement shall be immediately coated with zinc rich (galvanising) paint.

Where necessary to fill small, corner or angular sections, duct slabs shall be cut to fit.

Each slab shall incorporate the manufacturer's clear mark / symbol that the slabs are reinforced. The Customer shall break one slab from every pallet delivered by the manufacturer in the presence of the Site Inspector / Site Engineer to demonstrate that the slabs are reinforced. On projects with more than 100 slabs installed, the Customer shall check each slab, once installed, with a covermeter to prove the presence of reinforcement, in addition to the above break test.

All pre-cast concrete slabs are to be accompanied by a slab lifter. The lifter shall be the VZ1 Kerb Stone Handle. The slab lifter shall be made available on site at taking over of the works.

Trenches within 5m of oil containing equipment in bunds shall be connected to an interceptor.

Slabs shall be designed so as to be manhandled by two persons.

4.9 FIBRE OPTIC CABLE DUCTS

Where fibre optic links to remote stations are specified, the Customer shall install C2 jointing chambers to joint the incoming fibre to the substation fibre network. The C2 chambers shall be located at the legs of the station end masts or adjacent to the cable sealing end structures.

For overhead line connections, the Customer shall provide a duct down the mast to the C2 chamber.

A dedicated sub duct is required between the C2 chamber and the control building.

4.10 STEELWORK

The specification for external structural steelwork has been included in Part 4 of the document (External Substation Works) to cover all steelwork supporting external equipment, gantries, masts, lightning masts, lighting poles, etc.

It shall be noted that this part of the Specification is equally appropriate for internal steelwork such as substation building frames, roofs and floors, ancillary steelwork, cable support systems, etc.

4.10.1 EXECUTION CLASS

All appropriate structural steelwork intended to both form part or to support part of the works, temporarily or otherwise, shall have an Execution Class 2 (EXC2) as given by IS EN 1090 and bear a CE mark. The following three documents shall be submitted to EirGrid for approval at least three weeks prior to appointment of the steelwork contractor:

- Factory Production Control (FPC) Certificate, appropriate for the Works, originating from a Notified Body.
- Welding Certificate, appropriate for the Works, originating from a Notified Body.
- Declaration of Performance (DOP) Certificate in conformance with the standard form in Annex III of the CPR. A performance shall be declared to meet all of the requirements of this Specification and as set out in IS EN 1090 at a minimum.

4.10.2 MATERIALS

Except where noted or agreed otherwise the particular grade of steel used shall be determined in accordance with the design standard IS EN 1993 or approved equivalent standard.

All steel in plate, section and bar form shall comply with IS EN 10025 or similar approved standard.

Structural hollow sections shall be hot rolled in Grade S355JOH to IS EN 10210 unless instructed otherwise by the Customer's Designer. Welded cold formed structural hollow sections shall not be substituted for hot rolled sections.

Cold formed sections (i.e. Cladding Rails and Purlins etc.) shall comply with IS EN 10219.

Identifying marks for the different grades of steel shall be provided in accordance with IS EN 10025.

Except in the case of special plate with through thickness properties guaranteed by the manufacturer, all plates and sections 40 mm or over in thickness shall be ultrasonically tested for laminations and shall meet the requirements of Class S1 of IS EN 10160. The Customer's Designer may specify that other plates be ultrasonically tested and, unless otherwise specified, they shall meet the requirements of Class S1 of IS EN 10160.

Dimensional tolerances of:

- i) Hot rolled sections shall comply with BS 4-1, IS EN 10210-2, IS EN 10056-1 and IS EN 10034
- ii) Cold formed section shall comply with IS EN 10162
- iii) Plates and flats shall comply with IS EN 10029 / IS EN 10051

Electrodes for metal arc welding shall comply with the requirements of IS EN ISO 2560. Ordinary bolts and nuts shall comply with BS 3692 and BS 4190.

Unless otherwise agreed, ordinary bolts and nuts shall generally be Grade 8.8.

Pre-loaded bolts, nuts and washers shall comply with IS EN 14399.

Design and associated detailing for fatigue, where relevant, shall be in accordance with IS EN 1993-1-9.

4.10.3 CERTIFICATION

Two copies of the manufacturer's test certificates and mill certification verifying that the materials comply with the relevant European Standards or approved equivalent standards, shall be submitted to EirGrid for all structural steel, bolting materials and welding consumables.

4.10.4 DRAWINGS

For all structural steelwork the Customer shall prepare the necessary general arrangement drawings and shop drawings for fabrication and shall be fully responsible for checking the accuracy of these drawings. Drawings shall be in accordance with IS EN ISO 4157.

On completion of the contract, the steelwork contractor shall provide the Customer with one hard copy and a digital copy of 'As Erected Drawings'.

4.10.5 INSPECTION

The Customer shall inspect the steel fabrication works to ensure specified standards are being met. Detailed records of such inspections shall be recorded and shall be made available to EirGrid. EirGrid also reserves the right to inspect the fabrication works before and / or during fabrication and should be given every cooperation during these visits.

4.10.6 FABRICATION

The fabrication and workmanship shall be to the best modern practices and shall comply with the requirements of IS EN 1090 EXC2 or similar approved. Only CE marked fabricators shall be engaged for the work.

4.10.7 HOLES

Holing shall be in accordance with IS EN 1090 or equivalent approved standard. Holes for pre-loaded bolts shall be in accordance with IS EN 1993-1-8 or equivalent approved standard.

4.10.8 WELDING

Welding shall be a metal arc process in accordance with IS EN 1011-1, the guidance given in IS EN 1011-2 as appropriate, together with other clauses contained in this section. The Customer's steelwork contractor's system for the management of welding shall meet the standard quality requirements described in IS EN ISO 3834-3.

All welding documentation (welder qualifications, welding procedure qualification records, welding procedure qualifications and associated work instructions) shall be reviewed for applicability by the person responsible for welding coordination.

The Customer's steelwork contractor shall ensure that constituent product materials to be welded are compatible with the welding procedure being used. Joints shall be

prepared in accordance with IS EN ISO 9692-1 and -2. Precautions shall be taken to ensure cleanliness of the connection prior to welding.

All welders and welding operators shall be tested to meet the requirements of IS EN 287-1 and IS EN 1418, as appropriate.

The Customer shall produce welding procedures in accordance with IS EN ISO 15609-1. All welding shall be carried out in accordance with the approved procedures.

Welding shall be carried out under the supervision of a competent and experienced welding supervisor. The Customer shall keep records to enable all main welds, in particular butt welds, to be identified with the welder responsible for production. Such records shall be made available to EirGrid if requested.

4.10.9 TESTING OF WELDS

Provided that it has been established that welding procedures in use can produce conforming quality when implemented in production, ongoing control of welding quality shall be maintained by routine testing.

Routine testing includes 100% visual inspection and a supplementary programme of non-destructive testing (NDT) which shall be undertaken by the Customer to ensure that the welding processes and welders / welding operators are producing work of a quality that is consistent with Execution Class 2. The benchmark for the quality of work required for Execution Class 2 is generally quality level C to IS EN ISO 5817. The supplementary programme of NDT shall be in accordance with IS EN ISO 17635.

100% visual inspection shall be carried out before welding, during welding and on completion to determine the production quality is being maintained. All welds are to be visually inspected by a competent person. Visual inspection shall be made in accordance with guidance given in IS EN ISO 17637 over the full length of the weld and before NDT inspection is performed.

Non-Destructive Testing [NDT] shall be carried out in accordance with the guidelines in IS EN ISO 17635. Persons carrying out NDT shall be competent and shall be certified by an authorised qualifying body in accordance with IS EN ISO 9712.

If examination of a weld surface is required, magnetic particle testing shall be used in accordance with the recommendations given in IS EN ISO 17638 and this shall be preceded by visual inspection undertaken by the NDT technician. If magnetic particle testing is impractical, penetrant testing may be used in accordance with the recommendations given in IS EN ISO 3452-1. Operators carrying out final surface flaw detection of the weld shall hold a current certificate of competence to Level 2 according to IS EN ISO 9712 in surface flaw detection of the relevant types of work, from a recognised authority.

If ultrasonic testing is required, it shall be carried out in accordance with IS EN ISO 17640, IS EN ISO 11666 using reference level to technique 1, evaluation reference level -14dB and testing level B unless determined otherwise by the Customer's Designer.

4.10.10 BOLTING

The use of bolts, including permissible stresses, size and pitch of bolts shall comply with the requirements of IS EN 1993 and IS EN 1090 or equivalent standard.

The combination of bolts and nuts (and washer if used) which may be used shall be to the requirements of IS EN 15048.

Fasteners manufactured to previous BS standards are not suitable for CE marking as they do not achieve the test requirements for loadability specified in IS EN 15048-2.

4.10.11 CRANE RUNWAY BEAM

Connections of runway beams shall comply with IS EN 1993-6 (or BS 2853 until withdrawn).

Crane rail erection tolerances shall be in accordance with IS EN 1993-6

Runway beams shall be tested in accordance with IS EN 1993-6 or BS 2853 and all Statutory Requirements - 14 days notice shall be given to the Customer's Designer and all other relevant bodies (Health & Safety Executive/Insurance Representatives) prior to testing.

The marking of safe working loads on runway beams shall comply with IS EN 1993-6 or BS 2853.

Robust stop-ends, of minimum height 150 mm, shall be positioned at each end of each runway beam.

4.10.12 ERECTION

Steelwork erection shall be in accordance with IS EN 1090 or equivalent approved standard.

Erection of steelwork shall be carried out in a safe manner in accordance with all relevant Safety, Health and Welfare legislation. A detailed written method statement for erection shall be produced by the Customer for review by the Customer's Designer at least three weeks prior to commencement of erection.

The Customer shall be responsible for the correct alignment and level of all steelwork and for the accurate plumbing of stanchions. The alignment, level and plumb of the steelwork shall be in accordance with the tolerances outlined in Part 6 of this Specification.

4.10.13 ANCILLARY STEELWORK

Stairs, ladders and walkways shall be designed and constructed in accordance with IS EN ISO 14122, Parts 1 to 4 and BS 5395-3 in conjunction with Part K, Stairways, Ladders, Ramps and Guards, of the Building Regulations.

Ancillary steelwork shall be hot dip galvanized to a minimum thickness of 610 grams per sq. metre to IS EN ISO 1461 before delivery.

Chequer plate shall be raised pattern, self-draining type, to IS EN 10025 Grade S275.

Handrailing shall generally consist of tubular steel standards and tubular steel railing cut and bevelled where necessary. Handrailing shall comply with the loading requirement for horizontal loads as set out in IS EN 1991-1. The tubing shall be in accordance with IS EN 10210-2 and IS EN 10025 Grade S 275JO.

Open grid flooring shall be of mild steel to IS EN 10025 S275. The depth of open grid shall be as shown on the drawings. The pattern shall be square or rectangular and the maximum spacing of bars shall be 50 mm. The maximum area of each opening shall be 1500 sq. mm.

Panel sizes shall be restricted to maximum size of 1660 x 1000 mm. Panel shall be supplied with 4 No. clips. Each clip shall be drilled to suit an 8 mm diameter stud. The clip shall be designed to fasten over the top of one load bearing bar.

Stair treads shall in general be either 800 mm or 500 mm long. Stair treads shall have a steel slip resistant front edge. Spun galvanized bolts, nuts, and washers to IS EN ISO 1461 shall be supplied with the stair treads for fixing treads to stringers.

4.10.14 STRUCTURAL STEELWORK PROTECTIVE COATINGS

All internal steelwork shall be treated and protected in accordance with section 5.5 of this Specification.

Where fire protection coatings are specified by the Customer, all steel members essential to the overall stability of the building shall be treated with intumescent paint coating to provide a 1 hour fire resistance (or higher if required by the Fire Safety Certificate) for the building in accordance with section 3.4 of this Specification. These coatings shall be shop applied.

Unless otherwise specified, all external steelwork including externally exposed holding down bolts and internal steelwork below ground floor level shall be hot dipped galvanized.

At the time of coating the surface cleanliness of the steelwork to be coated shall be in accordance with IS EN 8501-1. All surfaces to be coated shall be free of scale, rust, grease, oil, dust and other deleterious materials. Steelwork shall be blast cleaned to remove all mill scale and other contamination to BS 7079. The surface finish shall be to standard preparation grade Sa 2½ in accordance with IS EN ISO 12944-4.

Abrasive used during blast cleaning shall be selected in accordance with IS EN ISO 11124 and BS 7079. Sand blasting shall not be used.

Under no circumstances shall the friction contact surfaces be painted, greased etc. Friction contact surfaces shall have an approved robust masking material securely applied before the application of any priming, painting coats to the surrounding steelwork.

In the following locations the steelwork shall be unpainted:

- Steelwork to be encased in concrete and other surfaces in contact with concrete
- Crane rails

Any contamination of the treated steelwork surface shall be removed, using an approved solvent solution, before further protective coatings are applied. The finishing coats to all structural steel shall be a colour as specified by the Customer's Designer, in accordance with BS 381C and BS 4800.

All external steelwork including doors and louvers and internal secondary steelwork such as platforms, stairs, ladders, handrails, chequer plates and open grid flooring shall be appropriately galvanised to the site corrosion rate and design life of structure. Refer to EirGrid Functional specification XDS-GFS-17-001, Galvanised Fabricated Steelwork.

All galvanising shall be carried out by the hot dip process and shall conform with IS EN ISO 1461 or equivalent approved standard.

Attention shall be paid to the detail design of members in accordance with IS EN ISO 14713-2. Adequate provision for filling, venting and draining shall be made for assemblies fabricated from hollow sections.

Bolts, nuts and washers shall be hot dip galvanised, and subsequently centrifuged (spun galvanised) in accordance with BS 7371-6.

Where fire protection coatings are required to indoor steelwork members, associated bolts shall also be treated with intumescent paint to provide the appropriate fire resistance. The application of these coatings will be undertaken in situ.

4.11 SUBSTATION ROADS AND ACCESS WAYS

The access road to the substation site shall be designed to accommodate the vehicles intended to travel along it and bends incorporated into the road shall accommodate the turning circles for these vehicles. Where the access road crosses ditches, streams or creeks, a permanent bridge structure shall be provided. Access to the substation shall be provided by a double gate which shall open inwards. Access within the substation shall be provided by means of a 4.5 m wide reinforced concrete road as shown on the site layout drawing.

Where a transformer is required in the station the road shall be designed to take the load of the transformer transporter fully laden with the transformer.

Paved access suitable for transporting the type of equipment to be installed shall be provided to the doors of the 110 kV and 220 kV buildings.

On completion of the works any damage to the road will be made good prior to handover.

Roadworks shall be constructed using the following materials only (Materials marked with an asterix (*) have clause numbers relating to the NRA 'Specification for Road Works'):

- Granular material Type B, Clause 804* shall be crushed rock, other than argillaceous rock. The material shall be well graded and lie within the grading limits of Table 8/2 & 8/6 NRA Specifications for Road Works. The liquid limit, moisture content, Los Angeles Coefficient, and Flakiness Index, shall be in accordance with Clause 804*.
- Pavement concrete shall be Class C32/40.
- A separation membrane shall be used between all concrete slabs and the sub-base. The membrane shall be impermeable plastic sheeting, 125 microns thick laid flat without creases, with minimum 300 mm laps.
- Road slab reinforcement shall be C503 long mesh fabric in accordance with BS 4483. The 8 mm bars at 100 mm centres in the fabric shall be placed parallel with the longitudinal direction of the slab. Laps in longitudinal direction shall be 450 mm minimum. Laps in transverse direction shall be a minimum of 300 mm.
- Transverse joints comprising of contraction or expansion joints shall be provided at the following spacings:
 - Contraction joints maximum 14 m centres
 - Expansion joints maximum 42 m centres.
- Contraction joints shall comprise of the following
 - A sawn groove joint 10 mm wide at least one-quarter the slab depth
 - Dowel bars shall be 20 mm diameter at 300 mm spacing conforming to IS EN 10060 and IS EN 13877-3 with a minimum tensile strength of 250 MPa
 - A sealing groove (seals shall be hot applied sealants Type N1 or Type F1 complying with IS EN 14188-1 and applied in accordance with BS 2499-2)
- Expansion joints shall consist of the following:
 - A joint filler board 25 mm thick self expanding cork seal or from another approved compressible material.
 - Dowel bars in an approved sheath shall be 25 mm diameter at 300 mm spacing conforming to IS EN 10060 and IS EN 13877-3 with a minimum tensile strength of 250 MPa
 - A sealing groove (as above)
- Bituminous Bound Materials shall be in accordance with the Series 900 of the NRA 'Specification for Road Works'. Materials shall specifically be:
 - Dense Base and Binder Course Asphalt in accordance with Clause 906*
 - Close Graded Asphalt Surface Course in accordance with Clause 912*

- Hot Rolled Asphalt Surface Course in accordance with Clause 910*
 - Coated chippings in accordance with Clause 915*
 - Stone Mastic Asphalt (SMA) Regulating Course in accordance with Clause 937*
 - Polymer Modified Stone Mastic Asphalt (PMSMA) Surface Course in accordance with Clause 942*
- Surface dressing shall be designed and carried out in accordance with Clause 919* and the recommendations of the Institute of Asphalt Technology (IAT) – ‘Guidelines for Surface Dressing in Ireland’ current revision.
 - Precast concrete kerbs, channels, edgings and quadrants shall conform to IS EN 1340. They shall be laid and bedded in accordance with BS 7533-6 on a mortar bed.
 - Insitu concrete for footways shall be Class C32/40.

Tolerances shall be in accordance with NRA Specification for Road Works Clause 702 and Part 6 of this Specification.

All covers, gratings and frames in hardstanding areas shall be a minimum of Class D400 Ductile Iron in accordance with IS EN124.

Ramps shall be structural concrete ground slab with mesh fabric reinforcement with a minimum top cover of 50 mm. Finish shall be Class U4 brushed finish. This is textured finish with average depth of 1 mm.

Approved barriers shall be installed to protect electrical equipment from vehicular traffic based on design risk assessment e.g. exposed cable sealing ends.

4.12 SUBSTATION ACCESS FROM MAIN ROAD

The access road to site from the main road shall be a minimum of 4.5 m wide, compacted stone road with surface dressing or bitmac finish with the top surface sloped towards the sides for draining and with suitable drainage provisions. The necessity for surface dressing is only applicable for roads less than 1 km. The junction of the access road with the National road shall comply with the regulations of the National Roads Authority in Ireland, in particular in terms of its line of sight requirements.

Where the access road crosses ditches and streams or creeks, a permanent bridge structure shall be provided, suitable for carrying the heavy construction vehicles and transformer transporting vehicles. The bends in the access road shall accommodate the turning circles of the vehicles intended to travel along it, e.g. construction vehicles, transformer transporter, etc.

The road shall be restored to its original specifications upon completion of the project.

4.13 SUBSTATION COMPOUND OPERATIONAL LIGHTING

Lighting shall be provided for in the substation compound to facilitate operations during night time as per relevant EirGrid specification (XDS-GFS-14-001). The design of this lighting system shall be submitted to EirGrid for review at the substation layout design stage.

4.14 EARTHGRID

The earth grid shall function in accordance with the latest version of the EirGrid Earthing and Lightning Protection' document reference XDS-GFS-12-001 for further details.

An earth grid proposal must be submitted to EirGrid for acceptance in advance of construction commencement. See specification 'Transmission Station Earthing and Lightning Protection' document reference XDS-GFS-12-001 for further details.

4.15 TRANSFORMER AND EQUIPMENT BUNDS

Transformers shall be sited with clearances to building and other transformers in accordance with IEC 61936-1.

Transformer bunds, tanks and other equipment containing oil shall be designed as waterproof structures to IS EN 1992-3 and shall be tested in accordance with EirGrid bund testing requirements. Joints, if required, shall incorporate PVC waterbars. Swellable / Hydrophilic waterbars shall not be used.

The following shall be used in calculations for bund sizing:

- Minimum void ratio of 30% in stoned area
- 110% capacity of oil volume
- 200 mm freeboard

Bund slabs shall not drain by gravity but shall incorporate a fall to a suitably sized sump for drainage by an acceptable oil sensitive fixed pump. The pumps shall be approved by EirGrid. The effluent from the bund shall be routed through a suitably sized class 1 compliant (EN 858-1) full retention oil interceptor before joining the surface water drainage.

If bunds do not incorporate an above ground wall then another acceptable physical barrier preventing possible vehicular contact with a transformer shall be incorporated in the permanent site works.

A design risk assessment shall be carried out considering access into the transformer bund.

IEC 61936-1 guidance shall be followed regarding clearance from other transformers and non-combustible building surfaces. Otherwise fire-resisting separating walls shall be used.

All cables to pass over bund walls as opposed to through the bund walls. The bunds shall be filled with 50 mm single sized crushed limestone up to 50 mm below the level of the transformer plinth. Assume a void ratio of 30% for this stone.

EirGrid is open to permitting the use of proprietary products, such as Fire Protecting Grating, which could be used as alternatives to the single size stone in equipment bunds provided that the Customer demonstrates that his proposal is at least equal in performance in regard to fire resistance and storage volume.

Access shall be provided into the transformer bunds by means of steel or GRP stairs manufactured in accordance with this Specification.

Concrete Finishes shall be as described in Table 3.10-1 of this Specification.

The permissible tolerances in finished surfaces shall not exceed the limits shown on the checklist in the Appendix A.

The Bund Test Report shall be completed by the Customer in accordance Sign-off Sheet in the Appendix A.

4.16 LINE BAY GANTRIES & FOUNDATIONS

4.16.1 DESIGN

The Customer shall design the line bay gantries and their foundations in accordance with the relevant parts of Eurocodes.

4.16.2 GANTRY LOADING

The Customer shall use the specified load combinations for the design of gantries. Any physical loading due to the electrical or mechanical operation of the gantry shall also be allowed for.

5 SUBSTATION BUILDING WORKS

5.1 FOUNDATIONS WORKS

The building foundations shall be designed to take all the dead and imposed loadings into account.

A land drain shall be constructed around the building at the level of the cable pit floor slab.

Below ground walls shall be designed for a head of water of three quarters of the full depth below ground subject to a minimum of 1 m in accordance with BS 8102.

A suitably sized pump sump and fixed pump shall be supplied in cable pits. Pumps shall comply with the requirements this Specification.

Regardless of the exposure class used in design a minimum cover of 50 mm is to be provided for all buried concrete.

5.2 ARCHITECTURAL WORKS

The buildings shall be of concrete frame, steel frame or of masonry construction.

All block / brick internal walls are to be fair face block / brick and of natural colour. Where waterproof exterior renders are used, they shall be self-coloured.

A minimum clear height from the floor finish of 3m is required to the underside of any beam or ceiling in the control room unless agreed with EirGrid.

The control room shall be accessed via an internal lobby area.

The minimum heights of doors are as described in section 5.3.12 of this specification:

The battery room door shall open outwards and shall be lockable. A cable entrance below ground from the substation compound, into the control room shall be provided. It shall be possible to seal off this entrance once the control cables have been installed.

Sufficient openings shall be provided for control cables between the battery and control rooms. Where a standby generator is supplied, an opening between the control room and the generator shall be provided.

An appropriate agreed lockable storage facility shall be provided outside the control room for storage of SF6 gas unless otherwise specified.

The battery room shall accommodate all the station batteries as well as the free supply telecommunication battery. The size and mounting requirements of this battery shall be obtained from EirGrid.

The workshop shall contain a workbench and accommodate the storage facilities for the portable maintenance earths and tools for the substation.

5.3 SUPERSTRUCTURE WORKS TO INCLUDE WALL, MASONRY AND DOORS

5.3.1 WALLS AND MASONRY

The walls in the WC shall be skimmed plaster finish painted in washable 'fleck' paint or other approved heavy duty easy clean treatment. Selected 150 mm x 150 mm matt white wall tiles shall be provided on adhesive to splashback.

All face brick shall comply with the requirements of IS EN-1996-1-1, IS EN1996-2 for facing quality bricks. Units shall be laid in full bed mortar where appropriate. All joints shall be filled and compacted, and a joint thickness of 10 mm shall be maintained. Fairfaced walls to have struck joints.

The following two documents shall be submitted for the Customer's Designers approval at least three weeks prior to commencement of procurement of the relevant masonry product:

- Factory Production Control (FPC) Certificate, appropriate for the works, originating from a Notified Body.
- Declaration of Performance (DOP) Certificate in conformance with the standard form in Annex III of the CPR. A performance shall be declared to meet all of the requirements of this specification and as set out in the relevant harmonised European Normative.

Mortar shall be pigmented to match the masonry colour. Mortar for jointing shall be cement mortar in the proportions 1:1:5 by volume of cement to lime to sand unless otherwise specified. A 1:5 cement sand mortar may be used with a plasticizer in accordance with the plasticizer manufacturer's instructions.

5.3.2 MATERIALS – MASONRY UNITS

Masonry units should be selected from the types listed below and should conform to the appropriate clause in the relevant Standards:

- clay masonry units to IS EN 771-1
- calcium silicate masonry units to IS EN 771-2
- aggregate concrete masonry units to IS EN 771-3
- autoclaved aerated concrete masonry units to IS EN 771-4
- manufactured stone masonry units to IS EN 771-5
- natural stone masonry units to IS EN 771-6
- bricks of special shapes and sizes to BS 4729

Masonry units shall be from an approved manufacturer whose products shall be examined and approved by the Customer's Designer before work commences.

Masonry units shall be manufactured on a static block making machine using cement certified to IS EN 197-1 as appropriate together with aggregate conforming to the quality requirements of IS EN 771-3. Pigments shall conform to IS EN 12878. All units shall incorporate an efflorescence inhibitor. The blocks shall be cured in purpose built chambers.

Lime shall be in accordance with IS EN 459-1.

Sand shall be clean sharp river or pit sand, well graded and entirely free from loam, clay, dust or organic matter to the requirements of IS EN 13139.

Water shall be in accordance with IS EN 1008.

Plasticisers shall be in accordance with IS EN 934-3 and shall be free from calcium chloride or similar salts.

Cement Type CEM 1 shall be in accordance with IS EN 197-1.

Mortar shall be accurately gauged and thoroughly mixed, using the minimum amount of water required for workability. It shall be made in small quantities only. All mortar shall be used within half an hour of the addition of water to the dry mix and any mortar which has begun to set. All mortars shall be to BS 5628-3.

All internal walls shall be finished to the full height of the underside of the roof structure, with all the necessary independently certified fire penetration seals (in accordance with the fire certification provisions) incorporated. All service penetrations shall also be appropriately sealed. Allowance shall be made for trims, closures, standard door apertures, including lintels, beams etc.

All internal walls shall be constructed from suitable thickness, fairfaced concrete blockwork incorporating appropriate expansion joints. Fairfaced walls shall have struck joints.

External Walls shall be cavity masonry construction, insulated to meet the requirements of SI 259 of 2008 [Part L of the TGD, Conservation of Fuel and Energy – Buildings other than Dwellings].

Fairfaced block walls, except in the WC, shall be finished with a Polybond seal coat applied to the manufacturer's instructions. Two coats shall be applied.

5.3.3 BRICKWORK

A 3 m x 1.2 m panel of brickwork incorporating an expansion joint and a return shall be constructed at least 2 weeks in advance of the main brickwork construction and submitted for the acceptance of the Customer's Designer.

All possible measures shall be taken to prevent efflorescence in the brickwork including but not limited to laying the bricks dry, ventilating and keeping water out of the cavities.

If efflorescence appears on brickwork it should be removed by brushing off with a stiff dry bristle brush after the wall has dried out. The surface should then be cleaned with a dry synthetic chamois or high suction sponge using very little water and rinsing the

sponge frequently in fresh water. Chemical methods should not be used for removal.

5.3.4 BLOCKWORK / ARCHITECTURAL MASONRY

Blocks shall have a minimum compressive strength of 7 N/mm².

A 3 m x 1.2 m panel of blockwork shall be constructed for each type of blockwork utilised for the project at least 2 weeks in advance of the main blockwork construction and submitted for the acceptance of the Customer's Designer.

When blockwork is complete it shall be signed off by the Customer's Designer.

Collar bonded walls are not permitted unless specified by EirGrid.

Architectural masonry walls shall be constructed using Forticrete Masonry Blocks manufactured and supplied under an IS EN ISO 9001 registered quality system.

Where specified in the planning conditions, a 2m x 2m panel of architectural masonry shall be constructed at least 2 weeks in advance of the main brickwork construction and submitted for the acceptance of the Customer's Designer.

Stone facing shall be constructed in uncoursed squared specked rubble carefully laid in mortar with no stone more than 150 mm deep backed with concrete blocks. All stones shall be well treated and bonded with all internal joints well filled. In laying out the joints care shall be taken so that not more than four side faces form any continuous vertical face joint.

Joints generally shall be 10 mm thick. Joints on external walls which are to be pointed. Joints on all other walls which are to be plastered or tiled shall be raked out 20 mm deep as the work proceeds.

Brickwork, blockwork or stone masonry shall not be carried out during frost or when the air temperature in the shade is below 3°C, unless special precautions are taken which are approved by the Customer's Designer.

All materials associated with masonry reinforcement where required shall comply with the relevant clauses of IS EN 1996.

Sealants shall comply with IS EN ISO 11600.

5.3.5 LAYING DAMP PROOF COURSES

Materials for damp proof courses shall be in accordance with IS 57 (Part 1 and 2) or BS 743 or other material as approved by the Customer's Designer.

Damp proof courses (DPC) shall be bedded on a 1:3 (cement: sand) mortar bed. The courses shall be laid in lengths as long as practicable. Laps in damp proof courses shall be 225 mm long and sealed with an approved bituminous water proofing compound.

5.3.6 WALL TIES

Wall ties shall be in accordance with IS EN 845-1.

Wall tie spacing for 100 mm cavity shall be 450 mm vertically and 750 mm horizontally.

Additional ties should be provided around openings at 225 mm centres vertically and within 150 mm of the opening.

All ties shall be embedded a minimum depth of 50 mm in the horizontal mortar joints at the tie the course is laid and should be a minimum of 100 mm from any edges or corners.

5.3.7 MOVEMENT JOINTS

Movement joints should be provided in general in accordance IS EN 1996 -2.

Movement joint fillers shall be built in as the work proceeds. The filler shall be accurately placed in the thickness of the wall or leaf and not less than 12 mm nor more than 20 mm from the face of the work unless otherwise shown on the drawings. The raking out of joint fillers will not be permitted.

Movement joint sealants shall be applied in accordance with the manufacturer's written instructions to clean, dry surfaces.

Movement joints should be provided in general in accordance with the following guidelines:

Fixed Clay Masonry:	12 m centres
Calcium Silicate Masonry	8 m centres
Concrete Masonry	6 m centres

Wall Ties shall be provided at all wall junctions with Steelwork and Concrete at 450 mm centres unless specified otherwise by the Customer's Designer.

5.3.8 CHASES AND HOLES

Chases and holes shall only be cut with a mechanical tool made for the purpose with the approval of the customer's Designer and are subject to the following:

- When the masonry is less than 75 mm in thickness. Chases shall not be used.
- Where the masonry construction is of solid units in single leaf or cavity walls horizontal or raking chases shall not exceed $\frac{1}{6}$ of the thickness of the construction and vertical chases shall not exceed $\frac{1}{3}$ of the thickness of the construction.
- Where the masonry construction is to be penetrated by services, the holes for such services shall not exceed 300 mm x 300 mm without further consideration by the Customer's Designer.
- Vertical chases on opposite sides of a wall shall be offset relative to one another by a clear distance equal to the wall thickness.

5.3.9 LINTELS

Lintels should comply with IS EN 845-2. Reinforced concrete shall be used for openings over 2 m. Stainless steel lintels shall be used in cavity walls with brick outer leaf. Prestressed concrete planks shall be used for openings up to 2m only in non loadbearing walls unless agreed otherwise with the Customer's Designer.

Prestressed concrete lintels shall be placed rough side up and be propped in accordance with the manufacturer's requirements unless agreed otherwise with the Customer's Designer. Lintels should be bedded on mortar with a minimum of 150 mm bearing onto a full block. Galvanised steel lintels shall be used when specified on the drawings.

5.3.10 MORTAR TESTING

All testing of mortar shall be in accordance with IS EN 1015 and the results shall be available prior to the blocks being laid.

Trial mixes shall be carried out and half of the samples shall be tested at 7 days and the remainder at 28 days. The minimum 28 day crushing strength of the cubes shall not be less than the values specified.

5.3.11 TESTING OF BLOCKS

Blocks shall be tested in accordance with the requirements of IS EN 772.

As soon as the sources of the units have been approved by the Customer's Designer, suppliers certificates of recent tests carried out in accordance with the relevant Standards shall be obtained giving the following information:

- Compressive strength
- Absorption percentage
- Soluble salt content.
- Drying shrinkage or moisture expansion
- Density and tolerance in dimensions

10 No. blocks per 1,500 of each type of block (subject to a minimum of 10 blocks per type) shall be selected at random and sent to an accredited Testing Authority for testing during the course of construction. Results of all test shall be submitted to EirGrid.

5.3.12 DOORS / WINDOWS

No windows are to be included in the building envelope.

All doors shall have a CE mark in accordance with section 2.5 of the Specification.

All doors, including internal doors, shall have a minimum clear opening height of 2.25 m

and a minimum clear opening width of 950 mm.

All doors shall be capable of being opened to 180° so that they can be held open by a suitable retainer. All doors shall be lockable from the outside and easily opened from the inside using the emergency mechanism. All doors are also to be fitted with panic bars and shall swing outwards when opened.

Doors shall have the following minimum dimensions:

External Doors:

- Personnel Single – 2.25 m (h) x 0.95 m (w)
- Double Equipment – 2.4 m (h) x 1.8 m (w)

Internal Doors:

- Personnel Single – 2.25 m (h) x 0.95 m (w)
- Battery – 2.25 m x 0.95 m (w)
- Double Equipment – 2.4 m x 1.8 m (w)

These minimum dimensions shall be checked against the equipment proposed for each station and internal door dimensions must match the external door dimensions.

All internal doors except the toilet door shall incorporate a visibility panel. The panels shall be sized in accordance with the Fire Report.

Depending on the GIS equipment to be installed roller shutter doors may be required to facilitate installation. Door sizes shall be consistent with the GIS Equipment manufacturer's requirements. Alternatives such as folding shutter doors or sectional overhead doors may also be considered. The degree of security and insulation will be dependent on the particular application to be agreed with EirGrid in advance.

Industrial doors including roller shutter doors, folding shutter doors and sectional overhead doors shall be designed in accordance with:

- IS EN 12433-1: Industrial, commercial and garage doors and gates - Terminology - Part 1: Types of doors.
- IS EN 12433-2: Industrial, commercial and garage doors and gates - Terminology - Part 2: Parts of doors.
- IS EN 12444-2000: Industrial, commercial and garage doors and gates - Resistance to wind load - Testing and calculation.
- IS EN 12425-2000: Industrial, commercial and garage doors and gates. Resistance to water penetration. Classification.
- IS EN 13241-1998: Industrial, commercial and garage doors and gates - Product standard.

Industrial doors shall be categorised as Wind Load Class 5 in accordance with IS EN 12444 unless agreed otherwise with EirGrid. For design wind loads less than 1.00 kN /m² , less onerous classes will be permitted subject to approval by EirGrid.

Industrial doors shall be categorised as Resistance to Water Penetration Class 3 in accordance with IS EN 12445.

5.3.13 INTERNAL DOORS / FIRE DOORS

5.3.13.1 INTERNAL DOORS – GENERAL

The internal doors shall comprise the following types:

- Flush 6 mm ply-faced, solid cored, 46 mm overall leaf thickness with hardwood lippings to all edges with hardwood timber frame and 6 mm plywood veneer finish suitable for painting.
- Flush 6 mm ply faced, solid cored, 56 mm overall leaf thickness with hardwood lippings to all edges with hardwood timber frame and 6 mm plywood veneer finish suitable for painting.

All timber door frames shall be taken from solid timber sections without the use of planted timber stops. The clearance gap between door edge and frame shall not exceed 3 mm at any point. The clearance gap between the bottom door edge and floor shall allow for floor finishes as necessary. Toilet cubicle and lobby doors shall be undercut as necessary to provide make up air for the extract system.

Timber doors shall be finished as follows:

Door leaves shall be finished with hardwood lips and 6 mm plywood veneer finish, suitable for painting. Door frames and leaves to be painted by brush on site as follows:

- 1 no. coat wood primer, sand lightly.
- 2 no. coats oil based undercoat, sanding lightly between coats.
- 1 no. coat eggshell oil based paint in selected RAL colour.
- Glazing panels shall be installed in doors as follows:
- Non-Fire Resisting Doors shall have 6 mm Georgian wired glass, polished, fixed with hardwood beads to detail and glazed in accordance to BS 6262-3.
- 30 minutes Fire Resisting Doors (FD30) shall have 6 mm Georgian wired glass, polished and fixed with hardwood beads with intumescent bedding to detail in accordance and within limits of fire door certificate to BS 476 Part 20 to 23
- 60 minutes Fire Resisting Doors (FD60) shall have 15 mm pyrostop glass set on 5 mm continuous bedding fixed with hardwood beads with intumescent bedding to detail in accordance and within limits in fire door certificate to BS 476 Part 20 to 23The use of insulated fire resisting glazing (i.e. Georgian wired glass) shall

be within the limitations as set out in the Building Regulations, TGD-B, Appendix A; Table A4.

5.3.13.2 FIRE DOORS

A fire door refers to a complete 'door-set' assembly which includes the door leaf or leaves, the door frame, ironmongery (hinges, latches, closers, etc.) and any seals where required between the frame and leaf or between leaves. The performance of the fire door shall critically depend on the correct installation of the complete 'door-set' assembly.

Fire doors shall be manufactured, installed and maintained in accordance with BS 476 Part 8 and BS 8214 and IS EN ISO 3864-1.

Fire-resisting doorsets shall be provided with construction and ironmongery tested to BS 476-22 providing a fire resistance of no less period than that specified in the Fire Safety Certificate. Intumescent strips shall be fitted to door frames and leaves as required. These strips shall be defined by the requirements of the certificate / evaluation.

Manufacturer's test certificates, reports, supplements and evaluations shall be provided to EirGrid prior to manufacture as evidence that all functions, sizes and glazing arrangements to be supplied are certified. It shall be the Customer's responsibility to ensure that the proof of performance is acceptable to the Fire Office / Fire Consultant and that all doors are certified. Uncertified doors will not be accepted by EirGrid. Fire rated door frames and leaves shall be provided by the same joinery manufacturer.

All fire doors shall be fitted with an automatic self-closing device which is capable of closing the door from any angle and against any latch fitted to the door.

Doors shall be hung on stainless ball bearing steel butt hinges with a melting point of at least 800°C unless otherwise specified with floor pivot hinges, etc. The number of hinges shall be in accordance with the fire certification.

All fire doors shall be marked (at about eye level, 1650 mm above floor level) with the appropriate fire safety sign complying with BS 8214 Part 1 and IS EN ISO 3864-1.

All fire doors shall be identified by a permanently fixed small flush metal plate, indicating the period of fire resistance, manufacturer, year of manufacture and all other pertinent details complying with the Building Regulations. Fire doors to cupboards shall be marked on the outside; all other fire doors shall be marked on both sides.

Firecheck glazing channels shall be an approved proprietary product, fixed with stainless steel screws and cups at centres not exceeding 100 mm staggered (minimum 2 no. per length).

Intumescent strips, seals, caulking and paste, shall be of an approved quality, design and manufacture to comply with BS 476. Where intumescent mastic is exposed it shall be 2-part colour black.

5.3.13.3 IRONMONGERY

Ironmongery shall be fitted as indicated in the Ironmongery Schedule in Appendix C of this Specification. Alternative ironmongery which is equal and approved may be used.

All ironmongery shall be concealed fixed. All pull handles shall be fitted with adequate fixings to ensure firm steady performance of pull handles. All forends, face plates and other accessories to timber doors shall be stainless steel to match all door furniture.

The ironmongery supplier shall ensure that locks supplied have adequate springs to ensure lever handles are maintained in the horizontal position when not in use.

All ironmongery products shall be as specified or equal approved to the Architect's approval. Lever handles must have metal bearings and be through screwed. Kick plate shall be a minimum 2 mm thick stainless steel and 200 mm high.

Samples required of all proposed ironmongery shall be provided to EirGrid prior to fitting.

All surface mounted door closers fitted to timber doors are to be fitted on the inside face of the door to each room. Closers shall not to be fixed on door faces to circulation areas.

5.3.13.4 GLAZING

All glazing shall meet the requirements of BS 6262 and where relevant IS EN 12600 or BS 6206 until withdrawn. Fire-rated glazing shall be ideally restrained by hardwood beads and intumescent strips.

5.3.14 EXTERNAL STEEL DOORS

The external doors shall comprise purpose made insulated galvanised 5 mm steel security doors with paint finish.

The Customer shall be responsible for the design, testing, fabrication, fitting of the door and frame including ironmongery, finishing and completion work. The doors shall be manufactured and installed by an approved supplier.

Shop drawings shall be prepared by the door supplier based on the Customer's Designer's drawings and shall include all interfaces with surrounding building fabric. No fabrication of the doors shall take place until all shop drawings are approved by the Customer's Designer.

All door leafs and fixed panels shall be filled with flexible / semi-rigid slabs or equivalent approved insulation with aluminium foil facing on slab side facing into the building, with the exception of any louvered elements.

All doors and frames shall be galvanised in accordance with IS EN ISO 1461 with paint finish as specified below.

The Customer shall obtain certification of acceptance inspection and sampling in accordance with IS EN ISO 1461 for all galvanised doors.

The paint finish shall be an approved two-pack polyurethane-acrylic anti-corrosion and

adhesion top coat in RAL 6020 'Chrome Green' or other specified RAL colour. Paint shall be applied in two coats to achieve a total dry film thickness of 120 microns.

5.3.15 MULTI-POINT DOOR LOCK

All single doors and all lockable steel doors shall be fitted with Mico Tindall MICO INT-3 AD2 Single Action to Escape (SATE) Surface Mounted Security 3 point Lock. The MICO INT-3 AD2 SATE is a surfaced mounted high security 3-point locking with integrated mechanical automatic deadlocking. The SATE override fitting offers panic escape at all times via a full width push plate.

The MICO INT-3 AD2 Sate shall

- include all accessories for fitting to doors of varying heights
- be in left hand and right hand configuration or be universal in design
- have a single action to escape mechanism on the interior
- be compatible with Euro profile DIN cylinders
- conform to IS EN 179

The Euro profile DIN cylinders shall confirm to the DIN Standard 18251.

Where required, steel doors shall be fabricated to receive a 102 mm long Euro profile mastered Federal cylinder fitted with a thumb turn. Doors shall be supplied on site with a 102 mm long Euro profile temporary builders cylinder. The provision of temporary cylinders shall be facilitated by EirGrid.

Cylinder for all locks excluding padlocks shall have a pickproof mechanism that is protected against manipulation. No components shall be used that could wear out.

5.3.16 CEILING

Plasterboard ceilings shall be in accordance with section 5.3.19 of this specification.

5.3.17 JOINERY

Timber shall be sound, well-conditioned, properly seasoned to suit the particular use and free from defects or combination of defects which could render it unsuitable for the purpose intended.

Timber used for grounds, battens, exposed grounds, exposed battens or fillets shall be red deal.

Timber used for joinery shall be as follows:-

1. Red deal of Northern Swedish or Canadian origin.
2. Iroko of African origin.

3. Southern Yellow Pine of American origin.
4. Ash.

All hardwood shall be well cut and shall be in conformity with samples approved by the Customer's Designer.

All timber shall be obtained from a sustainable timber source.

Hardwood, which is exposed to view in joinery work, shall be ash and shall be totally free from the following defects: knots, sapwood, waney edges, warping, pith, brittle heart, rot, stain and beetle attack.

Softwood timber, where used in joinery which will be exposed to view, shall be Red Deal of first quality. The following defects will not be permitted: pith shown on the surface; sloping grain exceeding one in eight; checks, splits and shakes; knots, excepting isolated sound tight knots of less than 19 mm diameter; any evidence of beetle attack or rot.

Softwood not exposed to view may be accepted with minor defects with the exception of beetle attack or rot.

The moisture content of the timber when the joinery is manufactured shall be within the following limits:-

- Minimum 15%
- Maximum 20%

All plywood shall be WBP bonded first grade and shall be faced with veneer as specified.

Medium density fibreboard (MDF) shall comply with IS EN 622-1.

Fire-proof board shall be a non-combustible, asbestos free, laminate board with calcium silicate matrix reinforced with vermiculite and natural organic fibres.

Screws shall comply with BS 1210 and nails with BS 1202. The size and material of screws and nails shall be appropriate to the nature of the fixing and of the materials involved.

Timber shall be stored under cover clear of the ground and protected from dampness.

Workmanship generally shall be in accordance with BS 1186-2. The whole of the carpentry and joinery work shall be carried out in the optimum manner. Plates, ceiling joists, etc., shall be in one length where possible. All joints shall be made directly over supports and these shall be scarfed and spiked where required.

5.3.18 STRUCTURAL TIMBERWORK

The provisions of this clause governs the use of softwood structural timber members in roofs or floors.

Where the Customer supplies prefabricated trusses, he shall submit the following for review in advance of manufacture of the trusses:

- Design calculations (IS EN 1995-1-1),
- A design risk assessment,
- A permanent works design certificate
- A drawing outlining trusses and bracing.
- A materials specification
- Quality assurance documentation

Structural timberwork shall comply with IS EN 1995-1-1 for softwood structural members.

Timber for structural members shall be minimum strength class C16 to IS444 / EN338.

The species group and stress grade shall be marked on the timber.

The moisture content of all structural timber shall not exceed 22% at the time of erection.

The Customer shall provide documents from the timber supplier certifying that all structural timber complies with the specified grading treatment and moisture content requirement.

All works described in this Section shall be protected as necessary during the progress of the Works, cleaned down and left in perfect condition on completion.

5.3.19 PLASTERWORK

All plasterwork shall be carried out in accordance with IS EN 13914-2 and BS 8481.

Gypsum plaster shall be an approved product to IS EN 13279-1 and used in strict accordance with the manufacturer's instructions.

Plasterboard shall be an approved gypsum product.

Galvanised plaster stops for external use and uPVC plaster stops for internal use, fixed back to back, shall be provided at all junctions of dissimilar materials [e.g. concrete and blockwork] to prevent cracking in the plaster. The finished surface of plaster is to have smooth flush junction in the same plane off the wall.

Plasterwork which is to be applied to concrete blockwork shall comprise of a sand coat, a sand / cement float coat and a napped sand/cement top coat giving an overall depth 16-20 mm.

Plasterwork to be applied to in-situ concrete shall comprise of a sand/cement scud coat with an approved bonding agent, a 16-20 mm nominal overall depth sand/cement float coat and a napped sand/cement top coat.

Plasterboard ceilings shall consist of 3 no. coats of approved vinyl matt emulsion with roller applied texture on 12.5 mm plasterboard mounted from a suspended ceiling system. The finish on plain ceilings shall be 3 mm skim on 12.5 mm plasterboard on an approved gypsum suspended ceiling system.

Boards are to have a tapered edge with taped and filled joints. One coat of gypsum drywall primer shall be applied to all boards before painting.

Installation of all products shall be strictly to manufacturer's recommendations.

External render shall comply with IS EN 13914-1 "Design, preparation and application of external rendering and internal plastering, Part 1 - External rendering".

A sample panel shall be provided of the proposed external plaster finish and approved by the Customer's Designer before commencement.

5.3.20 METAL CLADDING

Cladding panels shall be composite metal panels provided by an approved manufacturer.

Each panel types shall be appropriate for its particular application taking into account such factors as roof / wall construction, roof pitch, direction of lay, etc.

The core insulation shall be a closed cell, CFC free and LPCB certified polyisocyanurate (PIR).

The panel thickness shall be indicated on the construction drawings and be sufficient to provide a U Value in accordance with current Building Regulations TGD Part L Conservation of Fuel & Energy.

The Customer shall ensure that the cladding manufacturer provides external coating and product warranties and guarantees on an individual project basis.

Firewall specification panels shall be used in buildings where the construction requires a period of fire resistance to BS476-22 for wall applications as may be indicated on the construction drawings. Steel and aluminium outer and inner facings shall have a Class 1 surface spread of flame rating to BS476-7 & shall be Class 0 as defined by the Building Regulations. The panel surfaces shall be rated EXT.F.AA [flat panels] and EXT.S.AA [sloped panels] for fire penetration and flame spread when tested to BS 476-3. The System shall have passed all the requirements of Loss Prevention Standard LPS 1181: 2003: Part 1: Issue 1 Ceiling Lining Test published by the Loss Prevention Certification Board [LPCB].

The Customer shall be responsible for the design and specification of the system in accordance with BS 5427-1. Responsibilities shall include determination of profiles, sizes and thicknesses of panels and sheets, the sizes, number and spacing of fixings, and incorporation of other accessories and fittings to ensure cladding / covering system will resist factored dead, imposed and design live loads, and accommodate deflections and thermal movements without damage, all in accordance with BS 5427-1.

It is incumbent on the Customer to ensure that a fully integrated design is provided by

ensuring appropriate coordination between the cladding supplier, the main civil works designer, the structural steel fabricator and other relevant parties such as door manufacturers.

Fasteners shall be to manufacturer's specification and detail. The number and location of cladding fasteners shall be as recommended by the cladding manufacturer to resist wind loads calculated in accordance with IS EN 1991-1-4 .

Junctions between the roof panel system and walls / penetrations shall be insulated with PIR board insulation. Any gaps shall be filled with a proprietary fire rated gun applied canister urethane insulation product.

The Customer shall determine the surface condensation risk of the cladding system using the method described in IS EN ISO 13788. Thermal insulation shall provide a satisfactory temperature factor (f_{min}), to ensure that damage and nuisance from surface condensation does not occur.

Flashings, trims and lap joint treatment shall be in accordance with the manufacturer's instructions. End laps and side laps including sealing details shall be in line with the manufacturer's instructions arranged with laps away from prevailing wind. An anti-condensation tape shall be applied at the butt joint between panels.

An approved EPDM faced polyethylene foam to suit the cladding profile shall be used as a profile filler.

Junctions between cladding and flashings shall be weathertight and neatly dressed down.

Purpose-made cold formed metal accessories, for both internal and external use, shall have the same material / finish as the face of the cladding.

In order to prevent electrolytic action at contact surfaces of supports and sheets of dissimilar metals, the Customer shall provide for isolating tape as recommended by cladding manufacturer at these locations.

When the roofing and / or the wall cladding to the building is completed, a label identifying the insulated panels shall be fitted. This label shall illustrate the type of Insulated panels fitted, to aid Insurers, Fire Officers, Owners and Occupiers in identifying the envelope composition.

The Customer shall provide full shop drawings for review and comment prior to fabrication as follows:

- a) *Schedule of all cladding showing true elevations of each variation and cladding type at 1:50.*
- b) *All details full size showing the proposed system and all adjacent fabric in section and in elevation.*

The Customer shall be fully responsible for the suitability of the system proposed particularly with relation to weather tightness, durability, structural adequacy and rigidity.

The Customer shall ensure that the cladding manufacturer / supplier, before

commencing detailed design, submits labelled samples of the following for his approval and approval of the Customer's Designer:

- Cladding panel,
- Selected paint finish,
- Top hat sections / gaskets as required by the proposed system,
- Fasteners.

5.3.21 OVERPRESSURE RELIEF

Where a building is to accommodate GIS equipment, the structural designer shall liaise with the electrical and equipment designers to consider whether over pressure relief vents will be required in the building envelope.

5.3.22 PENETRATION SEALS (FIRE PROOFING DETAILS)

This part of the specification sets out the requirements for the design, supply, delivery and installation of Penetration Seals (fire & smoke seals) for service penetrations in walls, floors and ceilings and any other fire seals required for compartmentalisation.

The Customer's subcontractor installing penetration seals shall be certificated as part of a third party certification scheme for installation of passive fire protection products such as; FIRAS (run by Warrington Fire Certification) or LPCB (run by the UK Loss Prevention Council) in the installation of penetration sealing and cavity barriers. The Customer shall be required to obtain evidence of such certification and be able to demonstrate by means of references (i.e., previous contracts) that the subcontractor is capable of designing and installing penetration seals of a type and scale required.

Penetration seals design / installation shall be as simple as possible and be constructed using one or more of the following fire stopping products as agreed with the Customer's Designer:

- Cementitious mortar (10:1 mix of vermiculite and cement or similar).
- Silicone based sealant material
- Mineral fibre
- Intumescent and / or ablative coatings and materials.

Where steelwork forms an interface with a penetration seal, this shall be protected by means of encasing in fire resistant material, intumescent paint, or equivalent. The fire resistance of the material shall be in accordance with the Fire Safety Certificate.

Where cables could act as a means of heat transmission through the penetration seal, these shall be coated with the same intumescent or ablative mastic used to form the penetration seal (which has test evidence for such "coat back" usage) to a distance of at least 150 mm either side of the penetration seal or as directed by the product

manufacturers installation literature.

The penetration seal surface shall be smooth and finished off flush with the surrounding floor / wall surface.

All penetration seal materials shall be non-combustible in accordance with BS 476 Part 4 or equivalent.

No material shall contain asbestos in any concentration. Penetration seals shall not affect cable ratings.

All penetration seals shall be effected using materials, products and systems which have been successfully fire tested (in an independent fire test laboratory) in accordance with BS 476 Part 20 in order to confirm that they can achieve 60 minutes (or higher as may be required in the Fire Safety Certificate) integrity and insulation when tested. The Customer shall obtain copies of such fire test evidence.

All penetration seals shall be labelled with a penetration seal number by means of a small robust indelible tag or nameplate (which should also include the fire rating, date installed and name of installer), securely fixed adjacent to the penetration seal to which it refers. Upon completion, a penetration seal schedule, listing penetration seal number, materials used to effect the penetration seal, fire rating and location shall be completed and included in the Safety File. The label shall identify that should the penetration seal become breached in anyway, repairs shall be undertaken in accordance with this specification.

5.3.23 TILING

The installation of tiling will generally be in accordance with BS 5385. Tiling is generally confined to splashbacks in the WC.

Tiles shall be selected tiles, size and finish to match EirGrid's requirements. The bedding and joint width shall be in accordance with the manufacturer's instructions. All adhesives, grout and edge protection products shall be proprietary products approved by the Customer's Designer and installed in accordance with manufacturer's instructions. Movement joints shall be edge reinforced to BS 5385-3.

Before placing orders, the Customer shall submit representative samples of 2 no. of each tile proposed for each application to ensure that delivered materials match samples (one tile shall be delivered to the Customer's Designer; the other to site).

5.4 SUBSTRUCTURE AND FLOORS

5.4.1 GENERAL SUBSTRUCTURE REQUIREMENTS

Building floors shall be laid on a Radon barrier on minimum sand blinding of 50 mm.

Where designated rooms of the building are heated such as the Battery Room, Mess Room, Control Room, Comms Room, etc. the requirements of TGD Part L, Conservation of Fuel and Energy - Buildings other than Dwellings, are applicable. In such cases, the floor construction shall incorporate a layer of proprietary rigid insulation of thickness

sufficient to provide a U-value in accordance with TGD Part L.

A 250 mm gas permeable hardcore layer shall be placed beneath the membrane / insulation comprising of clean, dry, well compacted broken stone, 10-50 mm with no fines. The hardcore layer shall be finished with a separate layer of clean, dry soft sand blinding as per above.

The structure shall be provided with a radon barrier having the following properties:

- Nominal thickness – 0.4 mm
- Tensile Strength (N/50mm) in accordance with EN12311-1 750
- % Elongation In accordance with EN12311-1 <30%
- Moisture Vapour Transmission Rate MVTR (g/m²/24h) <0.2%
- Radon Permeability (10⁻¹² m²/s) not greater than 10
- Radon Transmittance (10⁻⁷ m²/s) not greater than 17

The material must have a current Agrément Certificate. Sheets must be clean and free from dirt and grease before application.

All Radon protection measures shall be provided for under the slab to include an approved Radon membrane, a radon gas control system comprising a network of open based MDPE sump units linked by 110 mm uPVC pipes in accordance with IS EN 1401-1, each sump serving an area not greater than 200 mm². The 110 mm uPVC distribution pipes shall be installed falling gently toward the sump unit and should pass through the building wall and be connected to a 90° short radius bend and uPVC cap link at ground level. Capped and sealed vents shall be brought to a level of 150 mm above ground at the perimeter of the building.

Adjacent sheets of membrane should overlap by at least 150 mm and should be fully sealed using proprietary sealing tape and firmly rolled with a hand roller.

Where service ducts or pipes penetrate the membrane, gas tight joints shall be made using proprietary sealant tape and top hat units with retention clips.

Great care shall be taken not to puncture the membrane during subsequent construction activities.

Radon sumps should be placed on a minimum of 100 mm of hardcore.

On completion of the building, the Customer shall employ an independent specialist to test the radon levels over a 3 month period throughout the structure and issue a report on levels to EirGrid.

The loading on the substructure shall comply with the relevant parts of IS EN 1991-1 except where the design requires otherwise or a higher load specified in this Specification.

Ramps to doorways shall comprise a structural concrete ground slab with mesh fabric

reinforcement with a minimum top cover of 50 mm and a maximum fall of 1 in 12.

Doors shall not swing across the sloping part of any ramp.

All rooms in the 110 kV and 220 kV buildings shall be located a minimum of 150 mm above the surrounding ground.

The below ground elements of the structure shall be waterproofed as a Grade 2 (better utility) basement utilising Type A, Tanked protection in accordance with BS 8102 'Code of Practice for Protection of Structures against Water from the Ground'. uPVC water stops shall be incorporated into all joints. The tanking shall be protected by a proprietary bituminous board and drained by proprietary vertical drainage sheets connected to the surface water drainage system.

5.4.2 SUB-BASE TREATMENT

Floors shall be structural concrete slab cast on a compacted hardcore sub-base of minimum depth 250 mm. Floors shall incorporate a layer of rigid insulation where required (see 5.4.1) and a radon barrier / damp-proof membrane and associated radon protection measures.

All necessary foundation works to be incorporated to ensure floor support or the design loading and usage requirements.

Requirements of Part C and Part L of the Building Regulations Technical Guidance Documents shall be incorporated in the design and construction works.

5.4.3 STRUCTURAL CONCRETE GROUND SLABS - GENERAL

Slabs shall be structural concrete slabs of minimum compressive strength Class C28/35 to IS EN 206-1 designed in accordance with the design loading and usage requirements. Slabs shall incorporate as a minimum A393 mesh fabric steel reinforcement with a top cover of 40 mm.

Floor finish to be Class U3 finish produced by steel trowelling or power-floating by experienced workmen. This is a hard smooth finish suitable for directly receiving thin flexible sheet and tile paving bedded in adhesive and sealing for metal items in direct contact with the concrete.

Trowelling shall not commence until the moisture film has disappeared and the concrete is sufficiently hard to prevent the working of excess laitance to the surface. The surface shall be trowelled firmly and left free from trowel marks. Class U3 finish may be produced by power floating of concrete subject to the requirement that such work is carried out by experienced and skilled workmen.

5.4.4 FLOOR FINISHES & ABUTMENTS

Floor finishes shall incorporate an approved surface hardener/anti-dust agent. Unless noted otherwise, all abutment of floors to walls shall be isolated with 10 mm close cell polyethylene compressible filter strip and sealed with polysulphide sealant. Finished surfaces shall be within the tolerances listed in section 6.3 of this Specification.

Floor finishes shall generally be power floated and coated with two coats of approved dust sealer.

The control room concrete floor [i.e. under the raised access flooring] shall have thinned polybond coating applied in two coats in accordance with the manufacturer's instructions.

All abutments of floors to walls shall be isolated with 10 mm close cell polyethylene compressible filler strip. All expansion joints shall be sealed neoprene or two part polysulphide mastic sealant or equivalent agreed floor quality mastic.

Agreed non-slip acid resistant vinyl shall be fitted in the battery room, with continuous covered skirting to perimeter including door threshold which shall rise up the wall by 100 mm.

The toilet and lobby floor finishes shall be Altro Classic 2.5 mm with 150 mm formed skirting or equivalent agreed.

A proprietary slip resistant concrete floor paint, colour light grey, shall be applied to the stairs in two coats in accordance with the manufacturer's instructions. Yellow strips shall be included on the first and last step of each flights of stairs.

5.4.5 GIS CABLE PIT SLAB

Ground Floor / Cable Pit Slabs shall be reinforced concrete structural slabs on 50 mm concrete blinding on grade designed in accordance with the design loadings and usage requirements.

The radon gas control system and hardcore is not required beneath cable pits in applications where cable pits are used as these areas will be tanked.

Adequate falls to a drainage sump (3-phase cast iron submersible pump) with approved / agreed pump shall be provided such that standing water cannot collect.

A stairs shall be provided and the design should be compliant to relevant fire and safety standards. All openings including cable, duct and trench entries shall be appropriately sealed. The depth of the pit shall be adequate to facilitate installation of cables in a safe and efficient manner.

A proprietary slip resistant concrete floor paint, colour light grey, shall be applied in two coats in accordance with the manufacturer's instructions. The second coat shall not be applied until after installation of the cables.

The design shall incorporate confined space criteria as per HAS confined space documentation. Confined spaces shall be eliminated or mitigated at design stage.

5.4.6 GIS ROOM CONCRETE FLOOR SLAB

The GIS Room Floor shall consist of a structural concrete slab in accordance with this Specification. The floor shall construction shall generally be one of the following options:

- Insitu concrete slab

- Insitu concrete slab on metal decking, precast concrete planks or other permanent formwork
- Precast concrete floor consisting of hollow core slabs or similar

Other options should be included in the 'Design Criteria for Civil and Structural Works' and submitted to EirGrid for approval.

The concrete slabs will be supported by structural steel (or reinforced concrete beams) fixed to the main structural frame.

The floor level should be designed so to accommodate equipment rails and be within the tolerances specified by the GIS manufacturer.

The layout of the building shall be designed to sufficiently accommodate the safe installation and maintenance of equipment and all required clearances in accordance with the Electrical Engineer's requirements.

Stairs shall be provided to the GIS Room floor level and the design should be compliant to relevant fire and safety standards.

A proprietary slip resistant concrete floor paint, colour light grey, shall be applied in two coats in accordance with the manufacturer's instructions. The second coat shall not be applied until after installation of the GIS equipment and all associated electrical works.

All upper floor slabs shall be sealed around the external perimeter with suitably rated fire-stopping material.

The GIS room shall be sealed from any control room, access, egress area under the GIS floor level to prevent build-up of SF6 in these areas due to loss of SF6 from GIS or storage cylinders.

Earthing of the GIS building, and in particular the GIS floor slab, shall be undertaken in accordance with GIS manufacturer's recommendations.

Particular attention shall be paid to:

- laying of narrow meshed copper earth grid under the GIS floor
- bonding the reinforcing steel in GIS floor to narrow meshed earthgrid

A letter of compliance from the GIS manufacturer, confirming compliance with the GIS building earthing requirements, shall be submitted to EirGrid within 2 weeks of the start of civil construction.

5.4.7 GIS ROOM FLOOR STEEL COMPONENTS

Typically, a suspended structural steel floor comprising a grid of suitably spaced beams is provided at first floor level to support the GIS concrete floor slab over the cable pit / ground floor slab. Alternatively, the Customer may opt for reinforced concrete beams subject to agreement by EirGrid.

The support steelwork shall be hot rolled mild steel to IS EN 10025-1 and coated in accordance with section 4.10.14.

Steel plates and grating will be required to cover large floor openings associated with cable installation.

Steel floor covers shall be galvanised in accordance with IS EN ISO 1461.

All steel components shall be designed to support the design loading and usage requirements.

Fastening of flooring panels onto support steelwork shall be by non-protruding approved proprietary fixing clips. All ring type Current Transformers (CT's) shall be positioned above the cable pit at finished floor level. Maximum floor plate size to be 2m x 1m. A pair of lifting holes shall be drilled in each plate prior to galvanising.

All plates shall be marked on the underside in stenciled yellow paint with a unique number and a drawing of minimum A3 size with the original layout of the numbered plates framed and mounted on the wall in the switchgear room.

Suspended steel flooring shall be equivalent proprietary system agreed by EirGrid. The depth shall be based on the specified loads and spans determined by the support steelwork design.

Where access to the underside of the steel flooring is possible or required, fastening shall be by an approved proprietary clip. Where access to the underside is not possible or required, fix using countersink 6 mm diameter Tek screws. Screws shall not protrude so as to become a hazard to those working below the floor.

Clearance between adjacent steel flooring units shall not exceed 3 mm.

Gaps at junctions / edges with concrete / block walls shall be unfilled with steel plate and shall not exceed 5 mm.

5.4.8 GIS FLOOR CABLE DUCTS / TRENCHES

Sufficient cable ducting should be provided. Covers to cable trenches to be open grating on hot rolled mild steel support angles fixed to the cable trench walls. Steelwork support for GIS local control/bay controller cabinets to be hot rolled mild steel to IS EN10025-1 designed to support the weight of the cabinets.

Glass Reinforced Plastic (GRP) covers shall be used for floor cable ducts and trenches including closure pieces around installed cables. The covers shall be designed to withstand the GIS floor loading requirements.

Covers shall be required to have a solid surface and open grid covers shall not be provided. Appropriate tools for safely removing the grating shall be provided and made available on site at handover to EirGrid.

Where possible cable entry points shall be in line with the floor trenches to enable easier installation of cables. The seating shall be such that the top of the grating is level with the top of the floor. The covers shall be removable.

The Customer shall make provision for mitigation measures in his Design Risk Assessment for risks associated with removing the cover plates during future maintenance of the Station.

5.4.9 RAISED ACCESS FLOORS

Raised access floors shall be located in the Control Room. In general raised access floors shall be in accordance with IS EN12825: 2001. Elements shall be Class 6 in accordance with Table 1 of IS EN12825.

Floors shall be designed for the following loadings:

- Ultimate load capacity: ≥ 12 kN Point load;
- Working load: 5 kN point load.

Steelwork support for cabinets shall be hot rolled mild steel to IS EN 10025 2001 designed to support the weight of the cabinets.

Deflection shall be of Class A in accordance with Table 2 of IS EN 12825 (2.5 mm max deflection under working load). Raised access floors shall comprise of 600 x 600 mm panels of a high density particle board with a 0.5 mm galvanised steel sheet soffit and uPVC edge trims. Panels shall be covered with an anti-static laminate. The height of the raised access floor shall be as per relevant drawing (generally 325 mm total). Pedestals shall be P1000 Unistrut with P2072 base plates and P1003 top plates.

Earthing connection shall be double nut on base plate bolt. Stringers shall be P1000 Unistrut with continuous stringers in one direction. Deviations on panel dimensions shall be in accordance with Class 1 of Table 3 of IS EN 12825: 2001. Pedestal fixing shall be pedestal adhesive with every fourth pedestal base fixed with 2 no. 40 mm stainless steel hammer home anchors. All upturned sections shall be connected to main framework with M10 set screws. The top of the upstand unit shall finish flush with floor tiles. One suction lifter shall be supplied and stored in the control room.

The raised access floor shall be provided in accordance with the drawings and finished floor shall be flush with finished floor in the adjoining hallway.

The raised access floor shall be laid in accordance with the relevant supplier drawing with finished floor flush with finished floor in adjoining hallway. The Customer shall cut panels around the cabinets as required.

All dimensions shall be checked on site.

Testing of raised access floor elements shall be in accordance with Clause 5 of IS EN 12825.

Raised access floors shall be protected from rain / moisture entering through external doors and causing swelling / dimensional change to the floor tiles. External doors to room containing raised access floors shall be locked closed whenever possible.

Details of the raised access floor shall be submitted to EirGrid for review prior to installation.

5.4.10 BATTERY ROOM FLOORS

The battery room floor slab shall be finished 20 mm lower than the access corridor floor and a gentle ramp within the battery room shall connect the two levels to ensure that acid leakage spills are contained within the room.

The floor shall be coated as detailed in this Civil Works Specification.

5.4.11 CRANE

The Customer shall supply and install a single girder travelling crane of suitable capacity to meet the requirements for installation and maintenance of the GIS equipment. The crane shall be operated from a pendant controller which shall cover the GIS room and cable pit.

The crane hook height from the GIS room finished floor level shall be in accordance with the manufacturer's guidelines. It shall facilitate unrestricted removal of the tallest part of GIS equipment and shall at least meet the minimum crane hook height requirements for the current 110 kV / 220 kV / 400 kV GIS equipment term contract.

The crane shall conform to the requirements of BS466 (1984) and BS 2573 (1980). It shall incorporate every reasonable provision for the safety of all operations and maintenance personnel and shall conform to all the appropriate statutory Safety Requirements. Cranes shall be finished in Hazard Yellow BS 4800 ref. 08-E-51 and clearly marked with the Safe Working Load.

Cranes shall be adequate for the anticipated loads to be lifted. Limit switches shall be provided in both longitudinal and transverse directions. Where required, physical and electrical controls shall also be installed to prevent the crane striking the building structure (e.g. stair core).

5.5 CORROSION PROTECTION OF METALWORK

The Customer shall in his design specify the environmental classification used to IS EN ISO 12944 in designing the corrosion protection system for external metalwork. The exposure conditions to be catered for and other particular requirements for individual projects shall be agreed with EirGrid prior to commencement.

Notwithstanding the requirements for fire resistance, all interior metalwork shall have a corrosion protection system for environmental category 'C2' in accordance with IS EN ISO 12944.

All dissimilar metals to be separated from each other.

The Customer shall ensure that the design, construction and protection of all aspects of the Works are adequate for the conditions of exposure and operating conditions at the site taking into consideration the specified working life of the facility.

The Customer shall in his design, specify the environmental classification used (internal and external) to IS EN ISO 12944-2 in designing the corrosion protection system.

The cladding / roofing / glazing system shall take account of the provisions of BRE Digest 127-An index of exposure to driving rain. The protection system for cladding and roofing shall have a life to first maintenance of 15 years.

5.6 HEATING AND VENTILATION

Electrical space heating to be provided to all areas to maintain a design temperature of 21°C. Thermostatic controls to be provided for operation of all heaters routed through a timer. The Battery Room shall be heated by heaters which are suitable for use in a possibly explosive atmosphere. They shall be controlled by a capillary thermostat mounted in the Control Room.

Ventilation system shall be provided to ensure adequate ventilation for plant and personnel.

Battery room walls shall, at a minimum, incorporate 4 no. vents to provide a minimum of 4 no. air changes per hour by natural ventilation. These shall be wall mounted powder coated, galvanised steel louvered vents, 900 x 225 mm with insect mesh. Two of these shall be placed at low level on one side of the room and two shall be located just beneath ceiling level on the opposite side of the room to maximise air flow.

For security reasons, vents shall be constructed from hot-dip galvanised steel with a frame of minimum thickness of 3 mm and louvers with a minimum thickness of 4 mm. The finishes shall match the wall finish.

The Battery room shall have a minimum of two external walls and designed in accordance with IS EN 50272 -1.

Low level mechanical ventilation shall be provided in switchgear cable pits to remove any build-up of SF₆ gas prior to entry.

The WC shall be mechanically ventilated to provide 12 no. air changes per hour.

SF₆ vents shall be custom fabricated galvanised steel vents with insect mesh.

Removable vents for cable pulling shall be custom fabricated galvanised steel vents with insect mesh.

Vent covers, where indicated, shall be internal plastic covers with insect mesh and external proprietary ductile iron 200 mm sq. vent covers. Vents shall be formed through the wall with a 160 mm uPVC pipe.

5.7 TOILET FACILITIES

A unisex WC and toilet shall be provided subject to agreement in advance with EirGrid. Hot water to wash hand basins shall be provided by an instantaneous under sink heater. Suitable eye wash facilities shall be provided in the toilets and also in the hallway in the event of a battery acid spill.

A separate water tap shall be provided above the wash hand basin. Refer to Appendix B for Schedule of Sanitary Ware.

A plasterboard ceiling, in accordance with this Civil Works Specification, shall be installed in the toilet area.

5.8 Roof

Substation control building roofs shall generally be flat roofs of minimum 1:60 fall. A pitched roof design may be used by prior agreement with EirGrid in order to comply with the requirements of any planning conditions. The roof shall be equipped with a fully functioning leak free guttering system laid to falls. There shall be no internal downpipes.

All roofs shall be adequately insulated in accordance with TGD Part L – Conservation of Fuel and Energy.

Where a flat roof type is used, a parapet with a minimum height of 1100 mm shall be used.

Regardless of the type of roof adopted for the substation buildings less than 5 m high (e.g. pitched, hipped etc), the station must incorporate a precast concrete, with in-situ concrete screed (where appropriate) supported on a reinforced concrete ring beam or a reinforced concrete flat roof to ensure building security. This is not a requirement for roofs of height greater than 5 m.

Flat roofs shall be detailed and constructed in accordance with the flat roof construction specification below. Trussed roofs shall be designed and erected in accordance with EN 1995-1-1.

The roof covering shall be laid to provide a secure, free draining and completely watertight roof. Flat roof covering shall be mastic asphalt, laid by a licensed asphalt roofing contractor, protected by two coats of solar reflected aluminium paint laid on a separating membrane on rigid insulation on a vapour barrier on concrete screed laid to falls.

The Mastic asphalt roofing finish shall be inspected for compliance to standards prior to installation of any surface protection, insulation and filter membranes etc.

An access hatch to roof level and a ladder shall be provided for GIS Buildings at an appropriate location subject to a design risk assessment.

All roofs shall have a design risk assessment carried out on them to assess the requirement for edge protection or a fall arrest system to be incorporated into the roof.

The roof build-up for flat roofs shall be as follows:

- Base: Concrete Deck to be true plane and even from ridges, hollows and indentations and to fall of 1 in 60 to outlets.
- Separating layers: One layer Jute or Flax Reinforced Black Sheathing Felt impregnated with bitumen by an approved supplier to BS 747 Type 4a(I)
- Roofing Asphalt: Mastic Asphalt to be a proprietary Polymer Modified Asphalt fully certified by the BBA and to be manufactured under Quality Assurance scheme by an approved supplier

- Application: 2 Coats, Total Thickness not less than 20 mm.
- Isolating Layer: Proprietary Polyethylene / Polypropylene thermally bonded non-woven fabric applied loose with minimum 150 mm laps at all joints.
- Insulation: 120 mm thick tongue and grooved proprietary rigid extruded polystyrene insulation loose laid by an approved supplier.
- Filter layer: IKO Breather Plus laid loose with minimum 150 mm laps at all joints.
- Surface Protection / ballast: 50 mm river washed rounded loading gravel to an approved sample.

Roofs to areas along maintenance and fire exit routes shall be finished with 600 mm x 600 mm x 50 mm thick approved concrete paving on proprietary paving supports in lieu of gravel. These slabs shall have 6 mm open joints and shall have a “wood float” non slip finish.

Upstands shall be finished with 3 no. coats asphalt with an overall thickness of 20 mm with expanded metal lathing reinforcement mechanically fixed with screws and plugs at maximum centres of 300 mm in each direction. A 50 mm x 50 mm asphalt angle fillet shall be formed between horizontal and vertical asphalt planes.

Alternatively concrete block and concrete upstands shall be finished with 20 mm asphalt in 3 No. layers to surface prepared with an approved high bond primer.

A 25 mm x 25 mm chase shall be formed in a homogeneous structure backing to create a key for the top of asphalt upstands.

Two coats of external grade solar reflective emulsion shall be applied to all exposed asphalt in upstands.

Roofs shall be flood tested by the Customer as follows:

- Prior to testing, a thorough check that all necessary roofing work is complete and obvious defects have been remedied shall be carried out.
- Roof flood test shall be carried out immediately after membrane is installed
- Roof test shall be carried out before any external insulation is placed.
- All outlets shall be externally sealed and protected against damage from water pressure with temporary kerbs. Plugs shall not be used to seal outlets.
- The roof shall be carefully flooded to levels agreed with the Customer’s Designer, but in no case higher than existing kerb levels, and left for a period of 2 days. Regular inspections for leaks shall be carried out.
- On completion of testing, roofs shall be drained slowly ensuring that outlets do not overload or flood.
- Where leaks have occurred remedial measures shall be carried out and the roof shall be re-tested, as outlined above.

The Customer shall certify the integrity of the roof.

The Roof flood test shall not be carried out if electrical equipment below the roof could be damaged as a result of a leak during the test. Electronic testing shall be carried out if flood testing is not possible.

5.9 FIRE DETECTION AND FIRE ALARM SYSTEMS

To be in accordance with EirGrid Specification (Fire Detection & Fire Alarm Systems) XDS-GFS-15-001 and I.S. 3218: 2013.

5.10 LIGHTNING PROTECTION

Customer to supply and fix comprehensive lightning protection including conductive strapping and requisite earth connection points in accordance with IS EN: 62305 and EirGrid Earthing and Lightning specification XDS-GFS-12-001.

5.11 WATER SERVICES

The Customer shall allow for bringing a suitably sized water main into the Control Building terminating at point of entry with stop cock. An external stop cock / meter pit shall be provided. Individual isolation stop cock and valves shall be provided to enable removal and maintenance of individual water fed appliances and fittings.

Supplies shall be run in polyethylene pipework to a drinking water point and tank. A suitably sized non-metallic (minimum 340 litre capacity) insulated cold water storage tank complete with lid shall be provided in a high level position in the Control Building incorporating overflows (external discharge), ball valve, lids and lagging. Supplies from tanks to toilets etc. shall be run in copper pipework.

All materials and equipment shall be designed to withstand the most severe weather conditions anticipated at the site. Particular emphasis shall be placed on ensuring frost damage to water services and plumbing works does not occur.

5.12 PLUMBING AND SANITARY WARE

Materials shall be in accordance with the following standards:

Copper pipes	IS EN 1057 (hEN)
Cold Water uPVC pipes	IS EN ISO 1452 Part 2 & 3
Sanitary Pipework	IS EN 12056 Part 1 & 2
Sanitary Appliances	BS 6465 Part 1 - 4
uPVC plastic waste pipes and fittings	IS EN 1329-1
Unplasticised waste pipes and fittings (external diameters of 34.6 mm, 41.0 mm)	IS EN 1451-1

and 54.1 mm)

uPVC soil and ventilating pipes and fittings BS 4514
(external diameters of 83 mm, 110 mm,
160 mm)

C.I. Soil waste and ventilating pipes BS 416-1

Plastics connectors for use with horizontal BS 5627
outlet vitreous China W.C. pans

Plastics waste traps IS EN 274

Waste pipes for sanitary appliances IS EN 274

All above ground drainage and waste disposal installations shall also comply with TGD H – Hygiene, of the Building Regulations. All materials shall be checked for soundness before installation.

A sanitary ware schedule is attached in the Appendix B of this Specification.

A fire main shall generally not be required.

Where there is no local authority water main available in the vicinity, a bored well within the substation fence, with commissioned pump and suitable treatment, shall be provided to provide potable water standard (if possible). This water will be used for supply to WC and handwash facilities and not for drinking. The bored well shall be lined as required by subsoil conditions but for a minimum of 3m from the top of the well. Samples should be taken for water quality 1 week and 1 month after boring and sent to an approved laboratory for testing.

Installation shall be in accordance with IS EN 12056-5 and BS 6465.

Testing of all materials after installation shall be in accordance with IS EN 12056-5 and BS 6465.

All pipes and fittings shall be fitted in strict accordance with manufacturer's instructions.

The soils and waste system shall be installed in uPVC. Adequate access shall be provided throughout for cleaning.

5.13 MECHANICAL AND ELECTRICAL SERVICES

Mechanical and Electrical Services to be provided in accordance with EirGrid specification for Mechanical and Electrical Services - XDS-GFS-14-001.

Emergency Lighting to be supplied and installed in accordance with I.S. 3217: 2013.

5.14 INTRUDER DETECTION AND SECURITY MONITORING SYSTEM

To be in accordance with the EirGrid Specification. (Station Intruder Detection & Security monitoring System for Transmission Stations - XDS-GFS-16-001).

Additional security measures shall be implemented for substations considered to be located in 'high-risk' locations. These measures shall include, but are not limited, to the following:

- Reinforced concrete construction of inner and outer leaf of building;
- Use of a prison type design for perimeter concrete walls;
- Electrified fence located on top of perimeter wall;
- Outer wall with an anti-ram barrier at the access point;
- Steel panelled entrance gate;
- Positioning / location of entrance gate hinges;
- Installation of CCTV and Netwatch systems;

All proposed security measures shall be agreed in advance with Eirgrid.

6 TOLERANCES

6.1 PILES

Tolerances should not exceed the ICE Specification tolerances.

6.2 STEELWORK

Dimensional tolerances of rolled sections shall comply with BS 4-1, IS EN 10210-2, IS EN 10056-1 and IS EN 10034.

Plates and flats shall comply with IS EN 10029 / IS EN 10025.

Cold formed section shall comply with IS EN 10162. The alignment, level and plumb of the steelwork shall be in accordance with the following tolerances unless superseded by more stringent tolerances dictated by installation and operation e.g. overhead maintenance cranes.

Position	Permissible deviation of the erected column/support member from its specified Position	+/-5 mm
Level	Permissible deviation between erected column base, column cap, beam, truss and specified level. (level of beam should be taken on top of upper flange)	+/-3 mm
Plumb	Permissible deviation from vertical per 15 m of height subject to a maximum deviation of	+/-5 mm +/-15 mm

Crane rail erection tolerances are to be in accordance with crane manufacturer's requirements.

6.3 IN-SITU CONCRETE

The permissible tolerances in finished surfaces shall not exceed the limits shown below. Tolerances for building elements other than those listed in below shall be in accordance with BS 5606.

Type of Structure	Type of Irregularity	Type of Finish: FORMED			Type of Finish: UNFORMED		
		F1	F2	F3/F4	U1	U2	U3/U4
Bases for Electrical Equipment	See tolerances shown in Appendix A						
Mast Bases with Cast in Bolts	See tolerances shown in Appendix A						
Transformer Plinths	See tolerances shown in Appendix A						

Type of Structure	Type of Irregularity	Type of Finish: FORMED			Type of Finish: UNFORMED		
		F1	F2	F3/F4	U1	U2	U3/U4
Buried Concrete in foundations, culverts, retaining walls, etc	Deviation from line	+/-20	-	-	-	-	-
	Deviation from level	-	-	-	+/-20	-	-
	Variation in cross section dimensions	+10 -5	-	-	-	-	-
	Deviation from straightness over 1.5 m	+/-10	-	-	+/-10	-	-
Exposed concrete in columns, beams, retaining walls, abutments, bunds etc.	Deviation from line	+/-10	+/-10	+/-10			
	Deviation from level					+/- 5	+ /-3
	Variation in cross section dimensions	+10 -5	+10 -5	+10 -5			
	Deviation from straightness over 1.5 m	+10 -0	+10 -0	+5 -0		+ /-5	+ /-3
Floors	Deviation from specified floor thickness						+10 -0
	Deviation from specified level						+15
	Deviation from 3m straight edge				+5		

6.4 ROADS AND PAVEMENTS

Roads and Paving
<p>Tolerances shall be in accordance with NRA Specification for Road Works Clause 702 as follows:</p> <ul style="list-style-type: none"> - Road surfaces: ± 6 mm - Alignment ± 25 mm - Kerb alignment ± 13 mm <p>Refer to NRA specification for tolerances on surface regularity.</p>

6.5 DRAINAGE

The permissible tolerances in line and level shall be 6 mm in level and 25 mm in line between manholes or access points.

Appendix A: Quality Forms and Checklists

List of Forms and Checklists

- Concrete Quality Checklist
- Tolerance for Electrical Bases (including mast bases with cast in bolts)
- Tolerances for Transformer Bases
- Bund Test Sign-off Sheet
- Duct Proving / Cleaning Sign-off Sheet
- Masonry Duct Sign-off Sheet
- Palisade Fence Check Sheet

ESB Networks Substation Projects Concrete Inspection Report



Project:				Pour No. and Location:		
Concrete Cube refs:						
Concrete Delivery Docket No's:				Concrete Mix Report No:		
Concrete Strength Class:		Date & Time of Pour:		Air Temperature during pour:		

Pre-pour inspection – *boxes to be initialised - do not tick

Check	Contractor*	ESBI*	Comments
Subgrade adequate, compacted as appropriate.			
Levels of shutters correct.			
Formwork robust, stable, clean and adequate. Cable access, pit channels, sumps and falls to floor installed & correctly positioned.			
Shutter release agent applied.			
Joints and waterbar correctly positioned and secure.			
Embedded materials for equipment and cable ducts correctly positioned & secure. Reinforcement bar size, spacing and location correct. Starter bars and holding down bolts to spec.			
Reinforcement welded for earthing (if reqd.)			
Earth tails in place.			
Cover to reinforcement adequate, sufficient & spacers fixed to maintain cover.			
Suitable access for delivery & plant.			
Vibration and other finishing equipment available.			

Note: the Contractor in initialling each pre-pour item confirms that he has checked that item and that it is in accordance with the ESBI drawings and Specification, before proceeding with the pour.

Placing Inspection – *boxes to be initialised - do not tick

Check	Contractor*	ESBI*	Comments
Concrete delivery docket checked & filed.			
Slump conforms with delivery docket.			
Placing within 2 hours of batching.			
Air temperature during placing within the specification limits.			
Set of three cubes taken.			
Adequate compaction carried out.			
Adequate curing including cold/hot weather protection undertaken.			

Post Concreting Inspection – *boxes to be initialised - do not tick

Check	Contractor*	ESBI*	Comments
Concrete within tolerance.**			
Quality and consistency of finish in accordance with drawings.			
Cube strength recorded and satisfactory.			

**complete concrete tolerance checklist for all bases and transformer plinths

Signed for Contractor:

_____ signature

_____ date

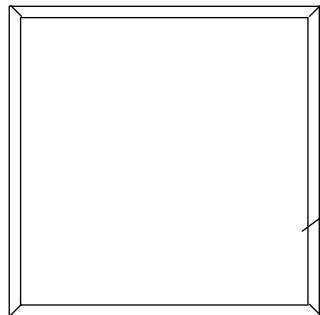
Signed for ESBI:

_____ signature

_____ date

Substation Base Checklist

Project:		Layout Drawing:	
-----------------	--	------------------------	--



Mark location
of levels taken
(min 4 corners
and centre)

Bases for Electrical Equipment				
No.	Deviation	Reqd. Tolerance	Sketch	Finish
i	Levelness-Deviation of any level from the specified level	+/- 10mm	<div style="text-align: center;"> Specified Level </div>	U3
ii	Flatness - The elevational difference between two points 1m apart, subject to a maximum difference of 10mm between any two levels on the base.	4mm	<div style="text-align: center;"> </div>	U3
iii	Vertical faces – variation in x-section	+10mm -5mm		F2
iv	Deviation from line	+ 20mm - 20mm		

Table 1 Tolerances for Bases for Electrical Equipment

Bases with Cast-in Bolts			
		Reqd. Tolerance	Finish
i	Deviation of level of cast in bolts from specified level	+10mm -5mm	U2
ii	Variation in line of individual bolts on each base (from template)	+ 1mm - 1mm	U2
iii	Variation in the centre line of bolts between connected bases	+ 5mm - 5mm	U2

Table 2 Tolerances for Cast-In Bolts

Base Reference	Date of Check	Specified Level	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Slots/Cutouts	Departure from line (mm)	Finish Acceptable	Required Remedial Works

Signed by: _____
signature

_____ date

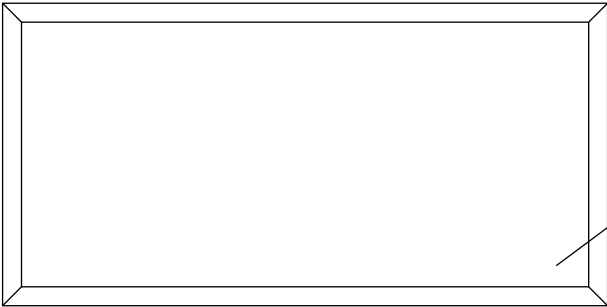
Original to: Project/Site QA File

Copy to: ESBI HO Project File

Substation Transformer Plinth Checklist



Project:		Transformer Plinth Ref:	
----------	--	-------------------------	--



Levels to be taken on a 1m grid
Mark location of levels taken

Specified Level	
-----------------	--

No.	Required Tolerance	
i	Departure of any level from specified level	$\pm 5\text{mm}$
ii	Difference between any two adjacent levels on the plinth	2mm
iii	Maximum difference between any two levels on plinth	5mm

Table 3 Tolerances for Transformer Plinths

Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9	Level 10	Level 11	Finish Acceptable	Slots/Cutouts	Required Remedial Works
Level 12	Level 13	Level 14	Level 15	Level 16	Level 17	Level 18	Level 19	Level 20	Level 21	Level 22			

Signed by: _____
signature date

Original to: Project/Site QA File Copy to: ESBI HO Project File

ESB Networks Substation Projects Bund Test Report

Bund Test

1. Fill the bund slowly with water to within 100mm of the top of the bund walls.
2. Leave the water for a period of 24 hours to allow the concrete to be completely saturated.
3. Top up water, if required, to within 100mm of top of wall. Mark the level of the water on the bund wall at the sump and at least one other location on the other side of the bund wall.
4. Fill an open vessel (e.g. bucket) with water to $\frac{3}{4}$ of its depth and mark the water level. Place the vessel adjacent to the sump to measure evaporation/rainfall during the test period.
5. After another 48 hours, check and record the level of the water at the same locations.
6. A drop of greater than 5 mm in the water level, adjusted for evaporation/rainfall is deemed to be a bund failure.
7. The checks are to be witnessed by the ESBI site inspector/site engineer.

Record of Bund Test

Project:	.....
Bund Ref. Number:	.....
Date and Time Water Level Marked:	.....
Date and Time Water Level Checked:	.....
Evaporation (-mm), Rainfall (+mm):	.....
Change in level (mm):	.....
Change in Level Adjusted for Evaporation/Rainfall (mm):	.....

Signed for Contractor:

signature

date

Name of Contractor:

Signed as witnessed by ESBI
Site Inspector/Site Engineer:

signature

date

ESB Networks Projects

Duct Cleaning/Proving Report

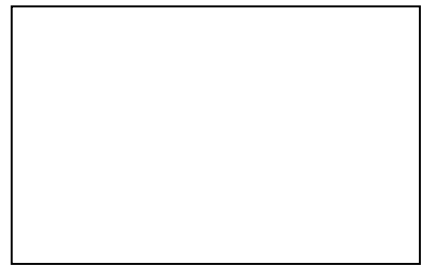
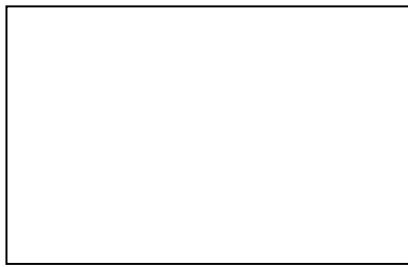


Project: _____

Duct ID	Duct Diameter(s) (mm)	Sponge Diameter (mm)	Brush Diameter (mm)	Mandrel Diameter (mm)

Winch Serial No. _____ Calibration date _____

Direction of proving from _____ to _____



Typical circuit cross section
& Ducts ID

Ducts formation & ID at
the start of the pull

Ducts formation & ID at the
end of pull

Pre-Taking Over

Duct ID	Duct Designation	Max Pulling Tension (tonnes)	Comments
1			
2			
3			
4			
5			

Have the ducts maintained the correct formation? **Yes** ☐ **No** ☐

Rubber bungs fitted after ducts proving? **Yes** ☐ **No** ☐

Have the ducts been cleaned and proved successfully? **Yes** ☐ **No** ☐

Signed for Contractor: _____
signature date

Name of Contractor: _____

**ESB Supervisor who
witnessed the tests:** _____
signature date

Note:

The proving of the ducts will be deemed as failed if:

- The pulling tension exceeds 1 tonne (10 kN)
- Mandrel is stuck
- Mandrel is moving with sudden bursts even if the pulling tension is less than maximum specified
- Rope shoots suddenly up the duct
- Ducts do not maintain the same formation as at the start of the pull

ESB Networks Substation Projects Blockwork Duct Inspection Report

Test on Precast Concrete Slab Reinforcement

All precast concrete slabs to be checked for the manufacturer's mark that they have been reinforced. A minimum of one slab per pallet to be broken in the presence of the ESBI site inspector/engineer to confirm the presence of and cover to mesh.

Record of Blockwork Duct Inspection

Project:	.....
Blockwork	.....
Duct Run(s):	.....

Has the duct a floated concrete base?:	.....
Are duct dimensions correct?:	.....
Is block size and bond acceptable?:	.....
Are mortar beds and joints acceptable (10mm)?:	.....
Is duct completely covered?:	.....
Is blockwork level/are any covers rocking?:	.....
Are covers firm and uncracked?:	.....
Have covers been tested (see above)?:	.....

Comments

--

Signed for Contractor: _____
signature date

Name of Contractor: _____

Signed as witnessed by ESBI
Site Inspector/Site Engineer: _____
signature date



ESB Networks Substation Projects

Palisade Fence/Gate Inspection Report

Check	Yes/No	Comments
DIMENSIONS Fence and gates min 2600mm high. Post Centres 2750mm. 50mm max between pales and pale to post. Gate dimensions as per drawing.		
FINISH All steel galvanised & powder coated. Powder coating undamaged. Steel members (poles, rails, posts) undistorted. No damage to fences or gates.		
FOUNDATIONS Foundations of adequate size 1100mm x 600mm x 600mm fence, 1000mm x 1000mm x 1000mm gate. Concrete C20/25, cubes taken & tested		
CONCRETE PLINTH Dimensionally correct 150mm deep by 250mm wide. Concrete finish adequate. Poles embedded 50mm min. Concrete C28/35, Cubes taken and tested.		
EARTHING Post to rail connection not powder coated. Earthgrid connections to fence/gate in place.		
GATES GENERALLY Gates open smoothly - level with good alignment. Receivers in place and working. All nuts are tight and washers used. Ends of bolts burred.		
CERTIFICATION Certificates of acceptance, inspection & sampling available.		

Signed by:

ESBI Civil Inspector/Engineer

signature

date

Appendix B: Typical Sanitary Ware Schedule

FITTING	TYPE	QUANTITY
WC	S3090 <i>Armitage Shanks Arc Concept</i> WC with bottom outlet S3652 <i>Armitage Shanks Arc Concept</i> push button single flush valve cistern, 4.5 litre , bottom supply and internal overflow, chrome plated push button S4040 Saturn seat & cover S9101 Domex screws (pair) S4325 Plastic outlet connector for connection to 102 bore Soilpipe	1 No.
Wash Hand Basin [WHB]	S2084 <i>Armitage Shanks Arc Concept</i> 56 cm washbasin with 2 Nos. tapholes overflow, no c/hole. S9110 lever handle steel hangers S2920 <i>Armitage Shanks Arc Concept</i> pedestal S7230 Avon 1/2 in non-concussive pillar taps (pair) chrome plated with anti splash outlet S9000 Isovalve servicing valve, inlet and outlet each with compression nut and ring for 15 mm copper tube S9145 Adjustable centre bracket in aluminium alloy for washbasins with wall to centre of waste outlet from 140 to 190 mm	1 No.
Mains Water Supply Tap	Over WHB wall mounted stainless steel tap for mains water supply with anti splash outlet - shall be agreed.	1 No.
Toilet roller Holder	Aluminium anti-theft type, plugged and screwed to blockwork/conc. wall	1 No.
Mirror	600 x 600 x 6 mm with bevelled edges with 4 Nos. screw holes, shall be fixed to blockwork/concrete wall, provide 4no. chrome screw cover caps.	1 No.
Heater	Under sink water heater	1 No.

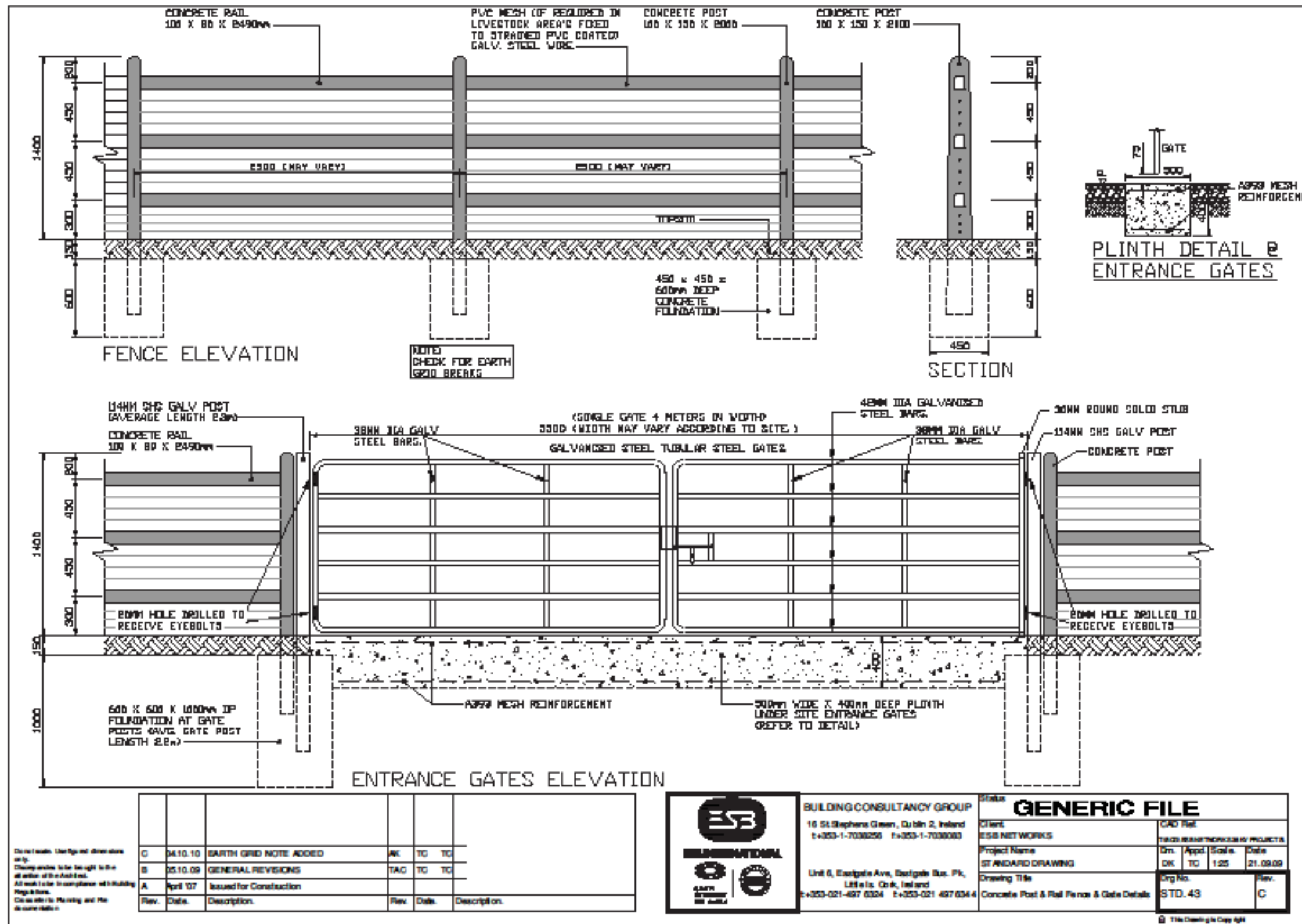
Appendix C: Typical Ironmongery

LOCATION	IRONMONGERY
External Insulated Steel Single Door Lockable	<p>3 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door)</p> <p>1 no. specified lock, cylinder & handle must be non-lockable from inside (sample required for client approval)</p> <p>1 No. Door Closer (must be suitable for weight of door)</p> <p>1 No. SAA Flush Bolts</p> <p>1 No. FA Easy Clean Socket</p> <p>Note: Recessed handle to be provided in door (EXTERNAL SIDE)</p> <p>External wall mounted retainer.</p>
External Insulated Steel Single Door Pushbar	<p>3 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door)</p> <p>1 No. Door Closer (must be suitable for weight of door)</p> <p>1 No. SAA Flush Bolts</p> <p>1 No. FA Easy Clean Socket</p> <p>Note: Recessed handle to be provided in door (EXTERNAL SIDE)</p> <p>External wall mounted retainer.</p>
External Insulated Steel Double Door Lockable	<p>6 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door)</p> <p>1 no. specified lock, cylinder & handle must be non-lockable from inside (sample required for client approval)</p> <p>2 No. Door Closer (must be suitable for weight of door)</p> <p>2 No. SAA Flush Bolts</p> <p>2 No. FA Easy Clean Socket</p> <p>Note: Recessed handle to be provided in door (EXTERNAL SIDE)</p> <p>External wall mounted retainer.</p>
External Insulated Steel Double Door Pushbar	<p>6 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door)</p> <p>2 No. Door Closer (must be suitable for weight of door)</p> <p>2 No. SAA Flush Bolts</p> <p>2 No. FA Easy Clean Socket</p> <p>Note: Recessed handle to be provided in door (EXTERNAL SIDE)</p> <p>External wall mounted retainer.</p>
Internal Single Room Door Fire Rated 1hr FR	<p>3 No. Class 8 Stainless Steel 110 mm Ballbearing Hinges Fire Rated</p> <p>1 No. Randi-line 300 x 25 mm S.S. Pull Handle</p> <p>1 No. Randi-line 300 x 75 mm S.S. Push Plate</p> <p>1 No. Randi-line S.S. Doorstop</p> <p>1 No. Chequerplate S.S.200mm Kicking Plate</p> <p>1 No. Dorma TS73 Silver Door Closer</p>

LOCATION	IRONMONGERY
	2 No. Randi-line SAA 'Fire Door Keep Shut' sign
Internal Single Toilet Door Fire Rated	3 No. Class 8 Stainless Steel 110 mm Ballbearings Hinges Fire Rated 1 Set Randi-line S.S. 21 mm Lever Handle on Back to Back Fixed Slimline Roses 1 No. Randi-line S.S. Cubicle Lock 1 No. Randi-line S.S. Slimline Indent Bolt & Thumb Turn 1 No. Randi-line S.S. Coat Hook 1 No. Randi-line 75 mm dia. SAA Unisex Symbol 2 No. S.S. 200 mm Kicking Plates 1 No. Randi-line S.S. Doorstop 1 No. Dorma TS73 Silver Door Closer
Internal Double Room Door Fire Rated 1hr FR	6 No. Class 8 Stainless Steel 110mm Ballbearing Hinges Fire Rated 2 No. Randi-line 300 x 25 mm S.S. Pull Handle 2 No. Randi-line 300 x 75 mm S.S. Finger Plate 2 No. Randi-line S.S. Doorstop 2 No. Chequerplate S.S. 200 mm Kicking Plates 2 No. Dorma TS73 Silver Door Closer 2 No. Randi-line SAA 'Fire Door Keep Shut' sign
Internal Door & Half Room Door Fire Rated 1hr FR	6 No. Class 8 Stainless Steel 110 mm Ballbearing Hinges Fire Rated 1 No. Randi-line 300 x 25mm S.S. Pull Handle 1 No. Randi-line 300 x 75mm S.S. Finger Plate 1 No. Randi-line S.S. Doorstop 2 No. Chequerplate S.S. 200 mm Kicking Plates 2 No. Dorma TS73 Silver Door Closer 2 No. Randi-line SAA 'Fire Door Keep Shut' sign
External Insulated Steel Single Door Lockable	3 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door) 1 no. specified lock, cylinder & handle must be non-lockable from inside (sample required for client approval) 1 No. Door Closer (must be suitable for weight of door) 1 No. SAA Flush Bolts 1 No. FA Easy Clean Socket Note: Recessed handle to be provided in door (EXTERNAL SIDE) External wall mounted retainer.
External Insulated Steel Single Door Pushbar	3 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door) 1 No. Door Closer (must be suitable for weight of door) 1 No. SAA Flush Bolts 1 No. FA Easy Clean Socket Note: Recessed handle to be provided in door (EXTERNAL SIDE) External wall mounted retainer.
External Insulated Steel Double Door	6 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door) 1 no. specified lock, cylinder & handle must be non-lockable from

LOCATION	IRONMONGERY
Lockable	inside (sample required for client approval) 2 No. Door Closer (must be suitable for weight of door) 2 No. SAA Flush Bolts 2 No. FA Easy Clean Socket Note: Recessed handle to be provided in door (EXTERNAL SIDE) External wall mounted retainer.
External Insulated Steel Double Door Pushbar	6 No. Stainless Steel Ballbearing Hinges (must be suitable for weight of door) 2 No. Door Closer (must be suitable for weight of door) 2 No. SAA Flush Bolts 2 No. FA Easy Clean Socket Note: Recessed handle to be provided in door (EXTERNAL SIDE) External wall mounted retainer.
Internal Single Room Door Fire Rated 1hr FR	3 No. Class 8 Stainless Steel 110 mm Ballbearing Hinges Fire Rated 1 No. Randi-line 300 x 25 mm S.S. Pull Handle 1 No. Randi-line 300 x 75 mm S.S. Push Plate 1 No. Randi-line S.S. Doorstop 1 No. Chequerplate S.S.200 mm Kicking Plate 1 No. Dorma TS73 Silver Door Closer 2 No. Randi-line SAA 'Fire Door Keep Shut' sign
Internal Single Toilet Door Fire Rated	3 No. Class 8 Stainless Steel 110 mm Ballbearings Hinges Fire Rated 1 Set Randi-line S.S. 21 mm Lever Handle on Back to Back Fixed Slimline Roses 1 No. Randi-line S.S. Cubicle Lock 1 No. Randi-line S.S. Slimline Indent Bolt &Thumb Turn 1 No. Randi-line S.S. Coat Hook 1 No. Randi-line 75 mm dia. SAA Unisex Symbol 2 No. S.S. 200 mm Kicking Plates 1 No. Randi-line S.S. Doorstop 1 No. Dorma TS73 Silver Door Closer
Internal Double Room Door Fire Rated 1hr FR	6 No. Class 8 Stainless Steel 110 mm Ballbearing Hinges Fire Rated 2 No. Randi-line 300 x 25 mm S.S. Pull Handle 2 No. Randi-line 300 x 75 mm S.S. Finger Plate 2 No. Randi-line S.S. Doorstop 2 No. Chequerplate S.S.200 mm Kicking Plates 2 No. Dorma TS73 Silver Door Closer 2 No. Randi-line SAA 'Fire Door Keep Shut' sign
Internal Door & Half Room Door Fire Rated 1hr FR	6 No. Class 8 Stainless Steel 110mm Ballbearing Hinges Fire Rated 1 No. Randi-line 300 x 25 mm S.S. Pull Handle 1 No. Randi-line 300 x 75 mm S.S. Finger Plate 1 No. Randi-line S.S. Doorstop 2 No. Chequerplate S.S.200 mm surface mounted ing Plates 2 No. Dorma TS73 Silver Door Closer 2 No. Randi-line SAA 'Fire Door Keep Shut' sign

Appendix D: Property Boundary Fence



Appendix E: Cable Duct Installation Guidelines

INTRODUCTION

This specification sets out the requirements for the supply and installation of ducts for High Voltage (HV) cables for substation projects.

MATERIALS (HV DUCTS AND COUPLERS)

All ducts and couplers shall be supplied by the Customer. All ducts/couplers shall satisfy the criteria given in the following Table E1:

<u>Property</u>	<u>Requirement</u>
Duct outside diameter for HV ducts	110 mm OD, SDR 17.6 – 38 kV 125 mm OD, SDR 17.6 – 110 kV 200 mm OD, SDR 17.6 – 220 kV
Duct Type	HDPE: 6 m lengths, 9 m on request
Duct Rating	Normal Duty per IS EN 61386-21 Specification
HDPE Quality	100% virgin material
Duct Colour - Outside	Red – BS 5252 Type 04 E 53 – 04 E 56. Minimum 1 mm thickness of colour material if dual layer extrusion
Duct Deformation Requirement	Shall pass IS EN 61386-21 < 5% deformation requirement for 450 N loading on 200 mm sample
Impact Resistance	Per IS EN 61386-21: 12 samples, 5 kg striker: 570 mm fall height: > 28 Joules – no crack in at least 9 samples
Duct Minimum Wall Thickness	The larger of the two criteria below: 1) Wall thickness to pass 5% deformation/impact requirement above 2) Minimum wall thickness as defined by SDR. (required for cable pulling)
Duct End	Ends of each length bevelled to allow easy jointing of duct on site, minimum thickness of plain end shall be 2.4 mm, bevel length > 5 mm
Circumferential Mark on Pipe End for Correct Push-in Distance	Circumferential mark required to indicate correct push-in distance for duct jointing. Location: to match half coupler length less half coupler centre stop thickness

<u>Property</u>	<u>Requirement</u>
Duct Ovality	2.0 mm maximum
Duct Inner Surface	Smooth low friction surface completely free of ripples, sharp edges and protrusions. Friction coefficient <0.20
Duct Marking	“DANGER ELECTRICITY CABLES”
Repetition: Rate/Gap between Legend	150 mm max. gap between adjoining legends
Colour of Legend	Black
Size of Lettering (Legend)	2 x 20 mm height i.e. 2 lines of 20 mm height @ 180° apart
Batch No/ Manufacturer’s Name and Date of Manufacture	To be stamped on the duct with a 6 mm minimum lettering size
Red Colour Fastness	1 year minimum required so as to provide 12 month storage period. 1 year outdoor weathering test required or suitable accelerated colourfastness test to prove
Endcaps for Ducting	Bag of 16 duct end caps shall be supplied with each bale of ducts – capable of fitting each duct end
Couplers	Slip or rubber gasket type with no internal obstructions/sharp edges. A centring ridge is required which does not protrude above the duct wall. The coupler shall effectively seal out water over the 40 year lifetime of the installation even at bend positions when buried 3 m below ground water level
Bends	38 kV and 110 kV ducts – No pre-formed bends. Form bends by evenly bending the duct (brace couplers so no bending stress on coupler) bending radius 6 m (under extreme circumstances can be reduced to 3 m minimum and shall be approved by the Customer’s Designer) 220 kV, pre-formed bends of 6 m radius (absolute minimum radius of 3.2 m with approval from the Customer’s Designer).

Table E-1
HV Ducts for 38 kV Offloading,
110 kV and 220 kV Cables

DUCT INSTALLATION

SAFETY AND OTHER UNDERGROUND SERVICES

If the Works are located in the vicinity of existing electricity cables, the Customer shall identify and bring to the attention of EirGrid any observations or reservations he may have in respect of the safe execution of the Works. All work areas shall have adequate fencing, lighting and guarding for the prevention of accidents and the safety of the public. The Customer shall establish a “Safe System of Work for Digging” and the guidelines listed therein shall be strictly enforced during excavation works. This document shall be submitted to EirGrid prior to the commencement of the Works.

Extreme care shall be taken to detect the presence of existing underground services. The Customer shall be responsible for identifying the whereabouts of all services including electricity cables along the route. The Customer shall ensure that he has in his possession all available records on the location of all services (including electricity cables) prior to commencement of excavation and shall maintain these records on site for reference for the duration of the Works.

The Customer shall take measures to ensure the full protection of pipes, cables and other apparatus during the progress of the Works for obtaining the written consent of the appropriate authority to interrupt the services of supply and for keeping EirGrid informed of all arrangements they make with third party asset owners or supplies, statutory undertakers and public authorities as appropriate.

The Customer shall open up an adequate number of hand excavated trial holes to determine the precise location of all services crossing or in close proximity to the line of the proposed trench before the laying of the ducts commences. The Customer shall take all possible precautions to avoid damage to services.

The Customer shall, during the progress of the Works, take account of all the requirements from statutory undertakers or from the management of any other publicly or privately owned services provided that these requirements are acceptable to and approved beforehand by EirGrid.

TRENCHING MATERIALS AND EQUIPMENT

The Customer shall provide all equipment and plant necessary for the trenching operation, including timber/plastic templates to correctly space the ducts.

TRENCH 'LAYOUT & DEPTHS'

Ducts and cables shall be installed in strict accordance with the project specific design drawings and instructions.

The trench shall be as level as possible in both directions. When changing grade to accommodate other services, the change in grade shall be as gradual as possible, generally 1:20, from the commencement of grade change to the obstacle, unless they have prior approval from the Customer's Designer. Thus the Customer shall prove the route, by excavation, two duct lengths ahead of each duct installation.

Clearances from other services shall be observed strictly. The minimum horizontal or vertical clearance is 300 mm unless instructed by the Customer's Designer. The maximum possible horizontal and vertical clearance shall be maintained at all times from main underground services. If a horizontal separation less than 1 m is proposed it shall be agreed in writing with Customer's Designer and any protection of the existing service provided.

Excavated material should not be stored close to the sides of the excavation or stored in such a place that it gives rise to potential health or safety hazard. The storage location for any excavated material shall be agreed in advance with the Customer's Designer.

The sides of the trench shall be adequately supported against collapse or slip, and to prevent debris falling upon the formation, bed, CBGM B mix or ducts. Continuous support shall be provided where the depth of the trench exceeds 1.25 m or as required in poor ground and in accordance with the latest edition of the HSA 'Guide to Safety in Excavations'

Removal of material which falls into the open trench due to sides caving in, collapsing or for any other reason will be the Customer's responsibility. All excessive excavation, ravelling etc. and its subsequent rectification to include removal of material and its replacement with compacted Clause 804 or CBGM B concrete as advised by the Customer's Designer will be the sole responsibility of the Customer.

Appropriate measures shall be put in place to ensure the trench remains free of standing water throughout the ducting process.

Where any soft or unsound spots occur in the trench formation, they shall be excavated to a depth determined by the Customer's Designer and filled to the correct formation with compacted Clause 804 or CBGM B concrete as advised by the Customer's Designer, depending on the ground conditions.

The formation shall be trimmed to an even gradient, cleared of mud etc. and approved by the Customer's Designer before the bedding material is placed.

BEDDING AND SURROUND

Bedding and surround to ducts shall be laid in accordance with the Specification.

CEMENT BOUND GRANULAR MIXTURE TYPE B*

Cement Bound Granular Mixture (CBGM) for duct bed and surround and trench backfill shall be CBGM B, in accordance with Clause 822 and the relevant Series 800 clauses of the NRA Specification for Road Works. The thermal resistivity shall be maximum 1.0 K.m/W.

A copy of field and material requirements for CBGM B is reproduced below in Table E-3:

Field Requirements	Category	CBGM B
	Clause	822
	Mixing	Mix-in Plant
	Method of Batching	Mass
	Cement type to IS EN 197-1	Only cements and cement combinations in Chapter 6 of this Specification may be used.
		The Customer shall submit any addition proposals to EirGrid for approval
	Colour	RAL 3000-3002 or BS 5252 Red – 04 E 53 to 04 E 56; pigment 225; 25 kg bag per 3 m ² of CGBM B Colour shall be specified by EirGrid.
	Moisture Content	To be optimised to achieve workability around 125 mm – 200 mm ducts to eliminate voids and maximise compaction while at the same time maximising thermal conductivity To suit requirements for strength surface level regularity and finish
Specimen Requirements	Minimum Compaction	95% of cube density
	Compaction	Clause 813.10 and Table 8/4
	Curing	Clause 813.14
	Compressive Strength Testing	Clause 825 – 1 no. test for every 50 m ³ but not less than 1 no./day
	Min. 7 Day Cube Compressive strength	15 N/mm ²
	Compressive strength Class	C16/20

Ducts shall be encased in CBGM B material, below and within structural areas of sub stations in accordance with the job specific requirements.

CBGM B shall be placed within 2 hours of production. Batch sheets shall be retained on site.

Prior to commencement of works, the Customer shall submit the name of the supplier and the proposed design mix and proof that it complies with the compressive strength and other requirements of the Specification.

Thermal Resistivity Testing

The Customer shall fill up/compact 4 No. 120 mm diameter x 220 mm high steel containers with 16 mm pin in the middle (concrete capacity 5 kg approx each) supplied for testing the thermal resistivity of CGBM B material. Testing shall be carried at an independent laboratory. The Customer will be required to review the concrete mix if the test results do not comply with the Specification.

SAND

Where instructed, the cables or ducts shall be surrounded with a compacted layer of natural unwashed sand in accordance with IS EN 12620. The grading, when determined in accordance with IS EN 933-1, shall comply with grading limit F in Table 4 of BS 882: 1992.

The compacted sand shall have a maximum resistivity of 1.0 K.m/W at 0 % moisture content. The Customer shall, before commencement of the Contract, select samples of at least 5 sands which fall within the above grading, and subject them to testing for thermal resistivity, particle distribution and dry relative density all at his own cost and submit the following information to EirGrid for his approval prior to commencement of the Works:

The source or sources of the material, and a 5 kg bag sample

Certificates of Compliance with the specified grading limits

Thermal resistivity test results demonstrating the ability of the material to meet the above criteria.

EirGrid will require sample tests to be performed on placed thermal sand in order to ensure compliance with the requirements of this Specification. One test will be required on each section of trench between adjacent joint bays. The Customer's Designer may also elect to carry out additional tests himself at his own cost.

CEMENT BOUND SAND

Cement bound sand shall be delivered mixed and shall be made from sand within the grading limits of Table 4 of BS 882 'Aggregates from Natural Sources for Concrete' reproduced in Table E-4 below.

The sand shall be mixed with cement at a ratio of sand to cement of 40 to 1.

The moisture content of the material shall be in the range of 8 % to 10 % when delivered and any water added to achieve this moisture content shall be added during the mixing process and not afterwards.

Cement bound sand shall be transferred directly from the truck to the work location in such a way as to prevent contamination and degradation of materials. Material shall be protected from the weather in the truck and prior to laying.

<i>BS Sieve Size</i>	<i>Percentage by Mass Passing</i>
10 mm	100
5 mm	89-100
2.36 mm	60-100
1.18 mm	30-100
0.60 mm	15-100
0.30 mm	5-70
0.150 mm	0-15

Table E-4

The material shall be placed and spread evenly and concurrently. Compaction of the material in place shall be carried out within two hours of the addition of the cement to the sand. It shall be carried out immediately after the material has been spread.

Where physical constraints exist, i.e joint bay, compaction shall be carried out by hand ramming in layers of 200 mm max. Ramming shall be carried out using ramming tools, which are adequate for the purpose. Addition of subsequent layers shall be carried out immediately so that, once compacted, the matrix of the material is not disturbed. Therefore the second layer of cement bound sand shall be placed within two hours of the manufacture of the cement bound sand in the first layer.

FILL MATERIAL TO STRUCTURES

Fill material to structures (concrete chambers) shall be granular material Class 6N or 6P and complying with Table 6/1 in the locations described in Appendix 6/6 of the NRA 'Specification for Road Works'.

The materials, Class 6N or 6P, shall be compacted in accordance with Clause 612* to satisfy the compaction requirements of the relevant class as listed in Table 6/1, but subject to the restrictions in the Clause 612.5 and Clause 612.6.

DUCT LAYING

Immediately on delivery of ducts, the Customer shall check that they comply with the Specification, in particular in respect of wall thickness, internal and external diameter along full length, straightness etc.

Each duct, coupler and joint shall be carefully examined for structural integrity and cleanliness immediately before and after laying.

Ducts may be cut provided that they are suitably held, supported in a safe manner and protected during the process. All ends shall be cut square to the longitudinal axis of the area and treated to ensure a smooth finish.

Ducts shall be spaced strictly in accordance with the Drawings.

Ducts shall be laid in straight lines to even gradients whenever possible. With prior approval of EirGrid, ducts may be laid to slow and even curves on plan to avoid

obstruction. If a change in direction is required, bends shall be formed by evenly bending the ducts only and the couplers shall be braced so that there is not bending or stress on the coupler. Pre-formed short-radius bends are not permitted, unless agreed with Customer's Designer.

For HV ducts, the radius shall not be less than 6 m. In order to avoid damage when bending ducts, no heat shall be applied to the ducts when joining ducts together via couplers.

When jointing ducts together with couplers, a suitable lubricant (specified by the Customer's Designer) shall be applied to the coupler to ease fitting. Ducts shall be tapped home until the white mark on the duct is reached. Ducts shall only be tapped with smooth timber or a plastic mallet to avoid damage.

Every effort shall be made to prevent dirt ingress into the ducts. Duct covers should not be removed until the duct is in the trench. The storing, handling and installation of the ducts shall be done in a manner so as to prevent the ingress of any foreign matter whatsoever. Ducts shall be capped with waterproof caps at the end of each day's work.

Proprietary expanding duct bungs shall be installed at the end of each duct laying section.

Note: Any dirt or pebbles trapped in the ducts could cause very expensive damage to the cables. During cable pulling, dirt or other sharp objects can be pressed between the duct and the cable resulting in deep scores and gashes on the cable sheath which can result in cable failure.

DRAW ROPES

A 12 mm polypropylene draw rope shall be supplied by the Customer and installed in all ducts to facilitate pulling in the cable.

The draw rope shall be fixed to the rear of the proprietary duct bung.

WARNING STRIP AND WARNING TAPE

Approved yellow warning tape and red warning strips shall be inserted in the trench at the locations shown on the Drawings. The warning tape shall be no deeper than 300 mm below ground. The Customer shall be responsible for collection and delivery of these items and for the correct placing of these items in the trench as detailed on the drawings of the trench cross sections.

TYING OF DUCTS

Ducts that are to be placed in trefoil formation shall be tied evenly at 3 m centres with an appropriate tie.

CLEANING AND PROVING

On completion of duct laying the ducts shall immediately be thoroughly cleaned internally to ensure no foreign matter including water remains inside. A sponge shall be used to remove the water from the duct section prior to proving. The sponges shall be minimum 10 mm greater than the internal diameter of the duct. The ducts shall be cleaned using a clean, stiff brush, with diameter as outlined in Table E-5

below, followed by two clear passes of a new foam plug.

Outside duct diameter (OD) and material	Minimum length of brush	Minimum diameter brush
110 mm HDPE	250 mm	100 mm
125 mm HDPE	250 mm	110 mm
125 mm uPVC	250 mm	120 mm
160 mm uPVC	250 mm	160 mm
200 mm HDPE	250 mm	187 mm

Table E-5: Sizes of Duct Cleaning Brushes

The duct diameter shall be proven using a mandrel, with diameter as outlined in Table E-6 below.

Duct dimensions			Minimum mandrel diameter
OD (mm)	ID (mm)	Duct Type	
110	97	HDPE	90 mm
125	117	uPVC rigid – standard ducting	105 mm
125	111	HDPE, SDR 17.6	105 mm
160	152	Existing uPVC duct	135 mm
200	177	HDPE, SDR 17.6	165 mm

Table E-6: Mandrel Sizes

The cleaning and proving of the ducts shall be carried out under supervision by the Customer's Designer. Cleaning and proving shall be carried out using a winch which has a calibrated dynamometer and printout provided. The dynamometer shall be calibrated annually and certified by an independent calibration tester. The certification shall be provided to EirGrid before any cleaning and proving activity takes place.

The duct cleaning/proving report (included in Appendix A), document CS17-01-057, shall be completed and submitted to EirGrid for all ducts. The report shall be signed by the Customer and counter-signed by the Customer's Designer's supervisor who has to witness the tests. Fully completed reports and print outs for each section of ducting shall be submitted to EirGrid for review.

The proving of the ducts will be deemed as failed if:

- The pulling tension exceeds 1 tonne (10 kN)
- Mandrel is stuck
- Mandrel is moving with sudden bursts even if the pulling tension is less than

maximum specified

- Rope shoots suddenly up the duct
- Ducts do not maintain the same formation as at the start of the pull

Should the duct testing and proving fail,

1. The Customer can clean and prove the ducting in the opposite direction to the previous proving direction,
2. A camera can be placed down the duct to check the internal integrity of the duct.

If the above steps do not meet the pass criteria then the Customer shall carry out repair works to rectify the fault. The repair works shall be carried out following the production of a method statement and risk assessment reviewed by the Customer's Designer.

Following the repair of the duct or ducts, the Customer shall also retest all the ducts within the circuit section of the repaired duct and as instructed by EirGrid even if these ducts had been successfully tested and proved prior to the repair works being done. If repairs are being carried out to a duct or circuit located within 500 mm of an existing bank of ducts, then EirGrid may request the testing of these ducts. The repair and retesting costs shall be borne by the Customer.

Following the duct proving process, approved rubber bungs with internal securing eye shall be fitted to prevent ingress of water, sand or other debris. The ducts shall then be left roped and the ropes secured to the internal securing eye in preparation for cable pulling.

INSTALLATION OF JOINT BAYS AND COMMUNICATION CHAMBERS

CONCRETE FOR JOINT BAYS AND COMMUNICATION CHAMBERS

In situ concrete for chambers, including joint bays, shall be Class C30/37 in accordance with relevant clauses of this Specification.

Exposure class	XC2
Minimum cement content	280 kg/m ³ .
Max. water/cement ratio	0.60
Cement type to IS EN 197-1:	Only cements and cement combinations in this Specification may be used. The following limitations apply. The Customer shall submit any addition proposals to the Customer's Designer for approval.
Minimum air content	N/A
Chloride content class:	Cl. 0,40
Max aggregate (mm):	20

Min. cover (mm)	40
Compressive strength class	C30/37

BACKFILL AND SURROUND

GENERAL

On completion of surround to ducts, backfill or cement bound granular mixture (CBGM B*) shall be placed and compacted in accordance with the Drawings provided by the Customer's Designer. Warning strip and warning tape shall be placed in accordance with Drawings.

Backfilling in cultivated grass verges, fields, parks and lawns etc. shall be carried out using suitable excavated material. The backfill shall be compacted in 150 mm layers using a vibrating plate compactor or power rammer in accordance with Clause 612 of the NRA 'Specification for Road Works'

Backfill of trenches beneath paved footpaths or margins shall be carried out using Granular Material Type B in accordance with Clause 804 of the NRA 'Specification for Road Works' laid in 150 mm layers compacted using vibrating plate compactor or power rammer in accordance with Clause 802 of the NRA 'Specification for Road Works'

AS-LAID RECORDS

INTRODUCTION

It is essential that accurate and up to date records are kept by the Customer for the location and depth of all underground electricity cables. The information is vital in order to meet the operational needs of the end-user and above all else to ensure the safety and welfare of its staff, the Customer's and the general public.

The Customer's Designer will supply background mapping in vector format, .dwg or .dwn. It is essential that any installed cable route is surveyed and placed on this vector map.

METHOD

Recording the As-Laid Record Information

The Customer may use the survey method of his choice to record the as-laid record, once the chosen method is capable of recording the information within the tolerances set out below by a qualified surveyor. At the project start-up meeting the Customer shall state their proposed method to capture the as-laid record. This proposal will be reviewed by EirGrid prior to ducting commencement on site.

Horizontal/Vertical/Accuracy

The cable/ducts shall be surveyed and plotted on the background mapping to an accuracy of ± 100 mm in the horizontal and vertical plane (Easting and Northing). The same accuracy is required for the surveying of all Joint Bays, C2 chambers, culvert crossings etc.

Cables / ducts shall be represented on the plot by one continuous Smartline/Polyline. All bends along the cable route shall be reflected accurately as they exist on the ground. This shall be in the form of a continuous curve. The use of tangent lines and points is NOT suitable for recording such information. A minimum of three points need to be surveyed on a bend, one at the start, one in the middle and one at the end. On larger bends, equally spaced survey points will be required.

Vertical Accuracy

The cables/ducts shall be surveyed and plotted on the background vector mapping to an accuracy of ± 50 mm in the vertical plane, the Z axis.

Points shall be recorded at a maximum of 15 m separation, where the trench installation is as per the standard trench cross section. The standard trench cross section is where the trench is at a total depth of 1000 mm – 1100 mm.

Where the trench depth deviates from the standard trench cross section, ie. deeper or shallower than 1000 mm – 1100 mm, depths shall be recorded as often as is necessary to achieve the tolerance as specified above subject to a maximum of 15 m separation.

All reduced levels shall be referenced to OSi datum mean sea level at Malin Head. All levels shall be taken on the upper crown of the top power ducts in the trefoil formation. The reduced level shall be annotated on the as-laid record.

Tie-In Dimensions

Tie-in dimensions shall also be measured and clearly marked on the plot. These shall be at 40-50 m centres along the cable route or closer as required. They shall also be at locations easily identifiable on the ground.

Cross Section Information

EirGrid has a requirement for regular cross section information. Cross sections are required where the vertical alignment of the cable/ducts deviates from the design depth to avoid an obstruction, major transmission gas mains or drainage pipes. The trench cross section should include details of these projects.

Cross sections are also required if the formation of the cable ducts deviate in any way from the standard trench cross section in the specification.

Existing Utility Services

EirGrid requires that ALL existing services exposed by the trench excavation be identified, recorded and plotted on the as-laid record. The location and depth of these services shall be recorded to the same tolerances as those outlined for recording the location of the cable ducts.

The as-laid record shall also be annotated with information detailing the type and size of the service e.g. Watermain 125 mm.

Plotting

The records information shall be plotted on the vector mapping.

Text shall be 2 mm high when plotted at a scale of 1:500. The text shall also appear

as horizontal to the sheet and shall not obstruct any linework.

Appendix F: List of Standards / Codes of Practice

BUILDING REGULATIONS AND TECHNICAL GUIDANCE DOCUMENTS

TGD Part A – Structure

TGD Part B – Fire

TGD part C – Site Preparation and Resistance to moisture

TGD Part D – Material and workmanship (CE mark)

TGD Part E – Sound

TGD Part F – Ventilation

TGD Part G – Hygiene

TGD Part H – Drainage and waste water Disposal

TGD Part J – Heat Producing Appliances

TGD part K – Stairways, Ladders, Ramps and Guards

TGD Part L – Conservation of Fuel and Energy – Buildings other than Dwellings: this regulation applies to the heated section of the building i.e. battery room, mess room, control room, comms room etc

TGD Part M – Access and Use

GENERAL

IS EN 1991 Eurocode 1: Actions on structures.

EARTHWORKS AND FILL

NRA Design Manual for Roads and Bridges

Volume 1: NRA Specification for Road Works

IS EN 1744-1: 2009 + A1: 2012 - Tests for chemical properties of aggregates. Chemical analysis

IS EN 1097-2: 2010 - Tests for mechanical and physical properties of aggregates. Methods for the determination of resistance to fragmentation.

IS EN 13249: 2014 - Geotextiles and Geotextile-related Products - Characteristics Required for use in the Construction of Roads and Other Trafficked Areas (excluding railways and asphalt inclusion) Amendment, February 2015.

IS EN 12224: 2000 - Geotextiles and geotextile-related products. Determination of the resistance to weathering.

IS EN ISO 10319: 2008 - Geosynthetics. Wide-width tensile test.

IS EN ISO 11058: 1999 – Geotextiles and geotextile-related products –.

Determination of water permeability characteristics normal to the plane, without load.

IS EN ISO 12956:1999 – Geotextiles and geotextile-related products –. Determination of the characteristic opening size.

IS EN ISO 12236: 2006 – Geosynthetics -- Static puncture test (CBR test).

IS BS 1377: Part 1 to Part 9 inclusive 1990 - Soil Testing.

IS EN 1097-2: 2010 - Tests for mechanical and physical properties of aggregates. Methods for the determination of resistance to fragmentation.

IS EN 1997-2: 2007 Eurocode 7 - Geotechnical design. Ground investigation and testing.

PILING

EN 1997-1:2004, Eurocode 7: Geotechnical design

“ICE Specification for Piling and Embedded Retaining Walls” published by the Institution of Civil Contractor’s Designers, London, (latest edition).

IS EN 1536: 2000 - Execution of Special Geotechnical Work. Bored piles.

IS EN 12699: 2000 - Execution of Special Geotechnical Work. Displacement Piles.

IS EN 12794:2005 - Precast concrete products. Foundation piles.

STEELWORK

IS EN 1090-1: 2009 + A1: 2011 - Execution of steel structures and aluminium structures. Requirements for conformity assessment of structural components (CE-Marking).

IS EN 1090-2: 2008 + A1: 2011- Technical requirements for the execution of steel structures.

IS EN 1993 Eurocode 3 subdivided in six parts: IS EN 1993-1, IS EN 1993-2, IS EN 1993-3, IS EN 1993-4, IS EN 1993-5 and IS EN 1993-6 Design of Steel Structures.

IS EN 10210 - Structural Tubes. Standard.

IS EN 10210 -1: 2006 - Hot finished structural hollow sections of non-alloy and fine grain steels. Technical delivery requirements.

IS EN 10219-1: 2006 - Cold formed welded structural hollow sections of non-alloy and fine grain steels.

IS EN 10160: 1999 - Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)

BS 4-1: 2005 – Structural Sections.

IS EN 10056-1:1999 - Specification for structural steel equal and unequal angles. Dimensions.

IS EN 10034: 1993 - Structural steel I and H sections. Tolerances on shape and dimensions.

IS EN 10162: 2003 - Cold Rolled Steel Sections.

IS EN 10029: 2010 - Hot-rolled steel plates 3 mm thick or above.

IS EN 10051: 2010 - Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels.

IS EN ISO 2560: 2009 – Welding Consumables.

BS 3692: 2014 - ISO metric precision hexagon bolts, screws and nuts. Specification.

BS 4190: 2014 - ISO metric black hexagon bolts, screws and nuts. Specification.

IS EN 14399 -10: 2009 - High-strength structural bolting assemblies for preloading.

IS EN ISO 4157 -1: 1998 - Construction drawings - Designation systems - Part 1: Buildings and parts of buildings.

BS 2853: 2011 - Specification for the testing of steel overhead runway beams for hoist blocks.

WELDING

BS 499:1991 - Welding terms and symbols (superseded).

IS EN 22553:1995 - Welded, brazed and soldered joints. Symbolic representation on drawings.

IS EN 1011-1: 2009 - Welding. Recommendations for welding of metallic materials. General guidance for arc welding.

IS EN 1011-2: 2009 - Welding. Recommendations for welding of metallic materials. Arc welding of ferritic steels.

IS EN ISO 3834-3: 2005 - Quality requirements for fusion welding of metallic materials.

IS EN ISO 9692-1 and 2: 2013 – Welding and allied processes.

IS EN 287-1: 2011 - Qualification test of welders. Fusion welding. Steels.

IS EN 1418: 1998 - Welding personnel - Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials.

IS EN ISO 15609-1:2004 - Specification and qualification of welding procedures for metallic materials. Welding procedure specification. Arc welding.

IS EN ISO 9606 series - Qualification test of welders - Fusion welding.

IS EN ISO 15614 series - Specification and qualification of welding procedures for metallic materials - Welding procedure test.

IS EN ISO 5817: 2014 - Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections.

IS EN ISO 17635: 2010 - Non-destructive testing of welds - General rules for metallic materials - Complementary element.

IS EN ISO 17637: 2011 - Non-destructive testing of welds - Visual testing of fusion-welded joints.

IS EN ISO 17635: 2010 - Non-destructive testing of welds -- General rules for metallic materials.

IS EN ISO 9712: 2012 - Non-destructive testing - Qualification and certification of NDT personnel.

IS EN ISO 17638: 2009 - Non-destructive testing of welds. Magnetic particle testing.

IS EN ISO 3452-1: 2013 - Non-destructive testing - Penetrant testing - Part 1: General principles.

IS EN ISO 17640: 2010 - Non-destructive testing of welds. Ultrasonic testing. Techniques, testing levels, and assessment.

IS EN ISO 11666: 2010 - Non-destructive testing of welds - Ultrasonic testing - Acceptance levels.

EN ISO 9712: 2012 - Non-destructive testing. Qualification and certification of NDT personnel.

BOLTING

IS EN 15048 Parts 1 & 2 - Non Pre-Load Bolt Assemblies CE Requirements

IS EN ISO 4018: 2011 - Hexagon head screws - Product grade C

IS EN ISO 4017: 2014 - Hexagon head screws -Product grades A and B

IS EN ISO 4016: 2011 - Hexagon head bolts - Product grade C

IS EN ISO 4014: 2011 - Hexagon head bolts - Product grades A and B

IS EN ISO 4034: 2012 - Hexagon regular nuts (style 1) - Product grade C

IS EN ISO 4032: 2012 - Hexagon regular nuts (style 1) - Product grades A and B

IS EN ISO 7091: 2000 - Plain washers - Normal series - Product grade C.

BS 4933: 2010 - Specification for ISO metric black cup and countersunk head bolts and screws with hexagon nuts.

BS 2583:1955 Specification for podger spanners

IS EN 14399 Parts 1-10: 2015 - High-strength structural bolting assemblies for preloading.

ANCILLARY STEELWORK

IS EN ISO 14122-1:2011 - Safety of machinery. Permanent means of access to machinery - Part 1: Choice of fixed means of access between two levels.

IS EN ISO 14122-2:2001 + A1:2010 - Safety of machinery. Permanent means of access to machinery - Part 2: Working platforms and walkways

IS EN ISO 14122-3: 2011 - Safety of machinery. Permanent means of access to

machinery - Part 3: Stairs, stepladders and guard-rails

IS EN ISO 14122-4: 2004 - Safety of machinery. Permanent means of access to machinery - Part 4: Fixed ladders

BS 5395-3:1985 Incorporating. Amendment No. 1: Stairs, ladders and walkways

IS EN ISO 1461:2009 - Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods

IS EN 10025: 2004 - Hot rolled products of structural steels

IS EN 10210-2:2006 - Hot finished structural hollow sections of non-alloy and fine grain steels. Tolerances, dimensions and sectional properties.

PROTECTIVE COATINGS

IS EN ISO 8501-1: 2007 - Preparation of steel substrates before application of paints and related products. Visual assessment of surface cleanliness. Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings

IS 7079: 2009 - General introduction to standards for preparation of steel substrates before application of paints and related products

IS EN ISO 12944-4:1998 - Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Types of surface and surface preparation.

IS EN ISO 11124-1:1997 - Preparation of steel substrates before application of paints and related products. Specifications for metallic blast-cleaning abrasives. General introduction and classification.

BS 381C Colour Chart. SML Paints and Coatings.

BS 4800 colour chart, swatches, cards, fans and books.

IS EN ISO 2808: 2007 - Paints and varnishes. Determination of film thickness.

IS EN ISO 14713-2: 2009 - Zinc coatings. Guidelines and recommendations for the protection against corrosion of iron and steel in structures. Part 2: Hot dip galvanizing.

BS 7079: 2009 - General introduction to standards for preparation of steel substrates before application of paints and related products.

BS 7371-8: 2011 - Coatings on metal fasteners. Specification for sherardized coatings.

CONCRETE

Particular Standards and Codes of Practice

IS EN 206 -1: 2002, Concrete - Part 1 (including Irish National Annex, 2010): Specification, performance, production and conformity.

IS EN 1992-3: 2006 Eurocode 2 - Design of concrete structures. Liquid retaining and containing structures.

IS EN 13670: 2009 - Execution of concrete structures.

IS EN 197-1: 2011 (including Irish National Annex, 2011): Cement. Composition, specifications and conformity criteria for common cements.

IS EN 12620: 2002 + A1: 2008 - Aggregates for concrete

IS EN 1008: 2002 - Mixing water for concrete. Specification for sampling, testing and assessing the suitability of water, including water recovered from processes in the concrete industry, as mixing water for concrete

I.S. EN 934-2: 2009 - Admixtures for concrete, mortar and grout - Part 2 (including including Irish National Annex, 2009): Concrete admixtures - Definitions, requirements, conformity, marking and labelling.

IS EN 12878: 2014 - Pigments for the colouring of building materials based on cement and/or lime. Specifications and methods of test.

Formwork and Falsework

BS 5975: 2008 + A1: 2011 - Code of practice for temporary works procedures and the permissible stress design of falsework.

CIRIA Report No. 108: Concrete Pressure on Formwork.

Reinforcement

IS EN 10080: 2005 - Steel for the reinforcement of concrete. Weldable reinforcing steel.

BS 4449: 2005 + A2: 2009 - Steel for the reinforcement of concrete. Weldable reinforcing steel. Bar, coil and decoiled product. Specification.

BS 4482: 2005 - Steel wire for the reinforcement of concrete products. Specification.

BS 4483: 2005 - Steel fabric for the reinforcement of concrete. Specification.

BS 6744: 2001 + A2: 2009 - Stainless steel bars for the reinforcement of and use in concrete. Requirements and test methods.

BS 8666: 2005 - Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification.

BS 7973-1: 2001 - Spacers and chairs for steel reinforcement and their specification. Product performance requirements.

IS EN 14889-1: 2006 – Fibres for Concrete. Steel Fibres. Definitions, specifications & conformity

IS EN 14889-2: 2006 – Fibres for Concrete. Polymer Fibres. Definitions, specifications & conformity

IS EN 14845-1: 2007 – Test methods for fibres in concrete.

Sampling and Testing of Concrete

IS EN 12390-1: 2012 - Testing hardened concrete. Shape, dimensions and other requirements for specimens and moulds.

IS EN 12390-2: 2009 - Testing hardened concrete. Making and curing specimens for strength tests.

IS EN 12350-1: 2009 - Testing fresh concrete. Sampling.

IS EN 12350-2: 2009 Testing fresh concrete. Slump-test.

IS EN ISO / IEC 17025: 2005 -General requirements for the competence of testing and calibration laboratories.

IS EN 12390 - Testing hardened concrete.

IS EN 12390-3: 2009 - Testing hardened concrete. Compressive strength of test specimens.

IS EN 12390-4: 2000 - Testing hardened concrete. Compressive strength. Specification for testing machines.

IS EN 12390-7: 2009 - Testing hardened concrete. Density of hardened concrete.

IS EN 12350 Parts 1 and 2. Defective Concrete

BS 1881-204: 1988 - Testing concrete. Recommendations on the use of electromagnetic covermeters.

IS 1881-206: 1986 - Testing concrete. Recommendations for determination of strain in concrete.

IS EN 12504-2: 2012 -Testing concrete in structures. Non-destructive testing. Determination of rebound number.

IS EN 12504-4: 2004 - Testing concrete. Determination of ultrasonic pulse velocity.

Precast and Prestressed Concrete

BS 5606: 1990 - Guide to accuracy in building

IS EN 57: 2014 - Safety rules for the construction and installation of lifts. Lifts for the transport of persons and goods. Passenger and goods passenger lifts.

IS EN 81-50: 2014 - Safety rules for the construction and installation of lifts. Examinations and tests. Design rules, calculations, examinations and tests of lift components.

BS 6954-1:1988 - Tolerances for building. Recommendations for basic principles for evaluation and specification.

ISO 3443-1:1979 -Tolerances for building - Part 1: Basic principles for evaluation and specification.

BS 6954-3: 1988 - Tolerances for building. Recommendations for selecting target size and predicting fit.

Ancillary Items

ASTM C1019 – 14: Standard Test Method for Sampling and Testing Grout.

“Concrete Advice No. 5” published by The Concrete Society in the United Kingdom.

“Code of Practice for the Design and Installation of Anchors” published by the HAS.

BS 7371-6: 1998 + A1: 2011 - Coatings on metal fasteners. Specification for hot dipped galvanized coatings.

IS EN 13811: 2003 - Sherardizing. Zinc diffusion coatings on ferrous products. Specification.

MASONRY

IS EN 1996-2: 2006 Eurocode 6 -Design of masonry structures. Design considerations, selection of materials and execution of masonry.

IS EN 771-1: 2011 - Specification for masonry units. Clay masonry units

IS EN 771-2: 2011 - Specification for masonry units. Calcium silicate masonry units

IS EN 771-3: 2011 - Specification for masonry units. Aggregate concrete masonry units (dense and lightweight aggregates)

IS EN 771-4: 2011 - Specification for masonry units. Autoclaved aerated concrete masonry units

IS EN 771-5: 2011 - Specification for masonry units. Manufactured stone masonry units

IS EN 771-6: 2011 - Specification for masonry units . Natural stone masonry units

IS 4729: 2005 - Clay and calcium silicate bricks of special shapes and sizes. Recommendations.

IS EN 998-2: 2010 - Specification for mortar for masonry . Masonry mortar.

IS EN 459-1: 2015 - Building lime. Definitions, specifications and conformity criteria.

IS EN 13139: 2002 - Aggregates for mortar

IS EN 934-3: 2009 + A1: 2012 - Admixtures for concrete, mortar and grout. Admixtures for masonry mortar. Definitions, requirements, conformity and marking and labelling.

IS EN 845-1: 2013 - Specification for ancillary components for masonry. Wall ties, tension straps, hangers and brackets.

IS 57: 1953 - Standard Specification (Bitumen Damp-Proof Courses)

BS 743: 1970 - Specification for materials for damp-proof courses

BS 6398: 1983 - Specification for bitumen damp-proof courses for masonry

BS 6515: 1984 - Specification for polyethylene damp-proof courses for masonry

BS 8215: 1991 - Code of practice for design and installation of damp-proof courses in masonry construction

IS EN ISO 1015-21: 2003 + A1: 2011 - Building construction. Jointing products. Classification and requirements for sealants.

IS EN 845-2: 2013 - Specification for ancillary components for masonry. Lintels.

IS EN 1015-21: 2002 - Methods of test for mortar for masonry. Determination of the compatibility of one-coat rendering mortars with substrates.

IS EN 772-11: 2011 - Methods of test for masonry units. Determination of water absorption of aggregate concrete, autoclaved aerated concrete, manufactured stone and natural stone masonry units due to capillary action and the initial rate of water absorption of clay masonry units.

ROAD WORKS

IS EN 10060: 2003 - Hot rolled round steel bars for general purposes. Dimensions and tolerances on shape and dimensions.

IS EN 13877-2: 2013 - Concrete pavements. Functional requirements for concrete pavements.

IS EN 13877-3: 2004 - Concrete pavements. Specifications for dowels to be used in concrete pavements

IS EN 14188-1: 2004 - Joint fillers and sealants. Specifications for hot applied sealants.

BS 2499-2: 1992 - Hot-applied joint sealant systems for concrete pavements. Code of practice for the application and use of joint sealants.

IS EN 14023: 2010 - Bitumen and bituminous binders. Specification framework for polymer modified bitumens.

COMPOUND STONING

BS 812-124: 2009 - Testing aggregates. Method for determination of frost heave.

DUCTING

IS EN 61386-21: 2004 + A11: 2010 - Conduit systems for cable management. Particular requirements. Rigid conduit systems.

BS 5252: Colour chart, swatches, cards, fans and books. RAL and BS colours for paints and coatings.

IS EN 933-1: 2012 - Tests for geometrical properties of aggregates. Determination of particle size distribution. Sieving method.

BS 882: 1992 - Specification for aggregates from natural sources for concrete (withdrawn).

WATER SUPPLY AND DRAINAGE

Drains and Sewers

BS 5911-1: 2002 + A2: 2010 - Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to IS EN 1916: 2002).

BS 5911-3: 2010 + A1: 2014 - Concrete pipes and ancillary concrete products. Specification for unreinforced and reinforced concrete manholes and soakaways (complementary to IS EN 1917: 2002).

BS 437: 2008 - Specification for cast iron drain pipes, fittings and their joints for socketed and socketless systems.

IS EN 598: 2007 + A1: 2009 - Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods.

IS EN 1401-1: 2009 - Plastic piping systems for non-pressure underground drainage and sewerage. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system.

IS EN 752: 2008 - Drain and sewer systems outside buildings.

IS EN 124-1: 2015 - Gully tops and manhole tops for vehicular and pedestrian areas. Definitions, classification, general principles of design, performance requirements and test methods.

Land Drains

IS EN 295-1: 2013 - Vitrified clay pipe systems for drains and sewers. Requirements for pipes, fittings and joints.

BS 3506: 1969 - Specification for unplasticized PVC pipe for industrial uses.

Water Mains

BS 5750-2: 1987, IS EN 29002-1987, IS EN ISO 9002-1987 - Quality systems. Specification for production and installation (superseded).

BS PAS 27: 1999 - Unplasticized poly(vinyl chloride) alloy (PVC-A) pipes and bends for water under pressure.

IS EN 545: 2010 - Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods.

IS EN 12201-2: 2011 + A1: 2013 - Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Pipes.

IS EN 1074-1: 2000 - Valves for water supply. Fitness for purpose requirements and appropriate verification tests. General requirements.

IS EN 1074-2: 2000 - Valves for water supply. Fitness for purpose requirements and appropriate verification tests. Isolating valves.

BS 750: 2012 - Specification for underground fire hydrants and surface box frames and covers.

Rainwater Goods

IS EN 612: 2005 - Eaves gutters with bead stiffened fronts and rainwater pipes with seamed joints made of metal sheet.

BS 460: 2002 + A2: 2007 - Cast iron rainwater goods. Specification.

IS EN 12200-1: 2000 - Plastics rainwater piping systems for above ground external

use. Unplasticized poly (vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system.

Oil Interceptors

IS EN 858-2: 2003 - Separator systems for light liquids (e.g. oil and petrol). Selection of nominal size, installation, operation and maintenance.

PALISADE AND WELDMESH FENCING & GATES

BS 1722-12: 2006 - Fences. Specification for steel palisade fences.

IS EN 13438: 2013 - Paints and varnishes. Powder organic coatings for hot dip galvanised or sherardised steel products for construction purposes.

FLOORS

IS EN 12825: 2001 - Raised access floors.

RADON BARRIER

IS EN 12311-1: 2000 - Flexible sheets for waterproofing. Determination of tensile properties. Bitumen sheets for roof waterproofing.

PLASTERWORK

IS EN 13914-1: 2005 - Design, preparation and application of external rendering and internal plastering. External rendering.

IS EN 13914-2: 2005 - Design, preparation and application of external rendering and internal plastering. Design considerations and essential principles for internal plastering.

IS 8481: 2006 - Design, preparation and application of internal gypsum, cement, cement and lime plastering systems. Specification.

IS EN 13279-1: 2008 - Gypsum binders and gypsum plasters. Definitions and requirements.

JOINERY

IS EN 622-1: 2003 - Fibreboards. Specifications. General requirements.

BS 5707: 1997 - Specification for preparations of wood preservatives in organic solvents.

BS 1186-3: 1990 - Timber for and workmanship in joinery. Specification for wood trim and its fixing.

BS 1210: 1963 - Specification for wood screws.

BS 1202-1: 2002 - Specification for nails. Steel nails.

BS 1186-2: 1988 - Timber for and workmanship in joinery. Specification for workmanship.

BS 476: Fire Tests.

BS 476-3: 2004 - Fire tests on building materials and structures. Classification and method of test for external fire exposure to roofs.

STRUCTURAL TIMBERWORK

IS EN 1995-1-1: Design of Timber Structures.

IS 444: 1998 - Use of structural timber in buildings

IS EN 338: 2009 - Structural timber. Strength classes

IS 435: 2005 - Timber Post and Rail Roadside Fencing.

DOORS

IS EN 12433-1: 2000 - Industrial, commercial and garage doors and gates - Terminology - Part 1: Types of doors.

IS EN 12433-2: 2001 - Industrial, commercial and garage doors and gates - Terminology - Part 2: Parts of doors.

IS EN 12444: 2000 - Industrial, commercial and garage doors and gates. Resistance to wind load. Testing and calculation.

IS EN 12425: 2000 - Industrial, commercial and garage doors and gates. Resistance to water penetration. Classification.

IS EN 1324: 1998 - Industrial, commercial and garage doors and gates - Product standard.

IS 6262-3: 2005 - Glazing for buildings. Code of practice for fire, security and wind loading.

BS 476-20: 1987 - Fire tests on building materials and structures. Method for determination of the fire resistance of elements of construction (general principles).

BS 476-21: 1987 - Fire tests on building materials and structures. Methods for determination of the fire resistance of loadbearing elements of construction.

BS 476-22: 1987 - Fire tests on building materials and structures. Method for determination of the fire resistance of non-loadbearing elements of construction.

BS 476-23: 1987 - Fire tests on building materials and structures. Methods for determination of the contribution of components to the fire resistance of a structure.

IS EN ISO 3864-1: 2011 - Graphical symbols. Safety colours and safety signs. Design principles for safety signs and safety markings.

IS EN 12600: 2002 - Glass in building. Pendulum test. Impact test method and classification for flat glass.

BS 6206: 1981 - Specification for impact performance requirements for flat safety glass and safety plastics for use in buildings.

IS EN 179: 2008 - Building hardware. Emergency exit devices operated by a lever handle or push pad, for use on escape routes. Requirements and test methods.

DIN 18251-1: Locks - Mortise locks - Part 1: Mortise locks for rebated doors.

DIN 18251-2: Locks - Mortise locks - Part 2: Mortise locks for tube frame doors.

DIN 18251-3: Locks - Mortise locks - Part 3: Mortise locks as multipoint locks.

TILING

BS 5385-3: 2014 - Wall and floor tiling. Design and installation of internal and external ceramic and mosaic floor tiling in normal conditions. Code of practice.

METAL COMPOSITE PANEL WALL CLADDING

BS 476-7:1997 - Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products.

BS 476-3: 2004 - Fire tests on building materials and structures. Classification and method of test for external fire exposure to roofs.

Loss Prevention Standard LPS 1181: 2003: Part 1: Issue 1 Ceiling Lining Test published by the Loss Prevention Certification Board [LPCB].

BS 5427-1:1996 - Code of practice for the use of profiled sheet for roof and wall cladding on buildings. Design.

IS EN 1991-1-4: 2005 - Wind actions.

IS EN ISO 13788: 2012 - Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods.

FLAT ROOF CONSTRUCTION

IS 747: 2000 - Reinforced bitumen sheets for roofing. Specification.

BS 5250: 2011 - Code of practice for control of condensation in buildings.

IS EN 13707: 2013 - Flexible sheets for waterproofing. Reinforced bitumen sheets for roof waterproofing. Definitions and characteristics.

IS EN 13304: 2009 - Bitumen and bituminous binders. Framework for specification of oxidised bitumen.

Information Sheet 18 'Code of practice for safe handling of hot bitumen for roofing purposes', in the FRCAB Handbook, produced by the Flat Roofing Contractor's Advisory Board and National Federation of Roofing Contractors.

BS 6229: 2003 - Flat roofs with continuously supported coverings. Code of practice.

BS 8218:1998 - Code of practice for mastic asphalt roofing.

PLUMBING AND SANITARY WARE

IS EN 1057: 2006 + A1: 2010 - Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications.

IS EN ISO 1452-2: 2009 - Plastics Piping Systems for Water Supply and for Buried

and Above-ground Drainage and Sewerage Under Pressure - Unplasticized Poly(vinyl Chloride) (pvc-u) - Part 2: Pipes.

IS EN ISO 1452-3: 2010 - Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure. Unplasticized poly(vinyl chloride) (PVC-U). Fittings.

IS EN 12056-1: 2000 - Gravity drainage systems inside buildings. General and performance requirements.

IS EN 12056-2: 2000 - Gravity drainage systems inside buildings. Sanitary pipework, layout and calculation.

IS 6465-1: 2006 + A1: 2009 - Sanitary installations. Code of practice for the design of sanitary facilities and scales of provision of sanitary and associated appliances.

BS 6465-2: 1996 - Sanitary installations. Code of practice for space requirements for sanitary appliances.

BS 6465-3: 2006 - Sanitary installations. Code of practice for the selection, installation and maintenance of sanitary and associated appliances.

BS 6465-4: 2010 - Sanitary installations. Code of practice for the provision of public toilets.

IS EN 1329-1: 2014 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticized poly(vinyl chloride) (PVC-U). Specifications for pipes, fittings and the system.

IS EN 1451-1: 2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polypropylene (PP). Specifications for pipes, fittings and the system.

BS 4514: 2001 - Unplasticized PVC soil and ventilating pipes of 82.4 mm minimum mean outside diameter, and fittings and accessories of 82.4 mm and of other sizes. Specification.

BS 416-1: 1990 - Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron. Specification for spigot and socket systems.

BS 5627: 1984 - Specification for plastics connectors for use with horizontal outlet vitreous china WC pans.

IS EN 274-1: 2002 - Waste fittings for sanitary appliances. Requirements.

IS EN 12056-5: 2000 - Gravity drainage systems inside buildings. Installation and testing, instructions for operation, maintenance and use.

FIRE DETECTION & FIRE ALARM SYSTEMS

I.S. 3218: 2013 - Fire Detection & Fire Alarm Systems.

MECHANICAL AND ELECTRICAL SERVICES

I.S. 3217: 2013 - Emergency Lighting