

GIS AND OTHER SUBSTATION BUILDINGS DESIGN

TS 2.010.10

GENERIC ELECTRICITY SUBSTATION DESIGN MANUAL
FOR CIVIL, STRUCTURAL AND BUILDING ENGINEERING

SECTION NO : 10

TITLE : GIS AND OTHER SUBSTATION BUILDINGS DESIGN

GIS AND OTHER SUBSTATION BUILDINGS DESIGN

This document is for internal and contract specific use only.

Disclaimer

NGG and NGET or their agents, servants or contractors do not accept any liability for any losses arising under or in connection with this information. This limit on liability applies to all and any claims in contract, tort (including negligence), misrepresentation (excluding fraudulent misrepresentation), breach of statutory duty or otherwise. This limit on liability does not exclude or restrict liability where prohibited by the law nor does it supersede the express terms of any related agreements."

TABLE OF CONTENTS

1 INTRODUCTION.....3

2 SWITCH HALL BUILDING [GUIDE DRAWINGS 1 & 2 REFER] 16

3 ANCILLARY PLANT ROOM BUILDINGS [GUIDE DRAWINGS 3 & 4].....22

4 MODULAR CONSTRUCTION 24

5 AMENITIES BLOCK [GUIDE DRAWINGS 5, 6 & 7].....28

6 STORAGE & WORKSHOP UNITS [GUIDE DRAWING 8] 32

7 EXTERNAL SITE FEATURES 33

PART 2 - DEFINITIONS AND DOCUMENT HISTORY 33

8 DEFINITIONS 33

9 AMENDMENTS RECORD 34

10 IMPLEMENTATION 34

PART 3 – GUIDANCE NOTE AND APPENDICES 35

11 GUIDE DRAWINGS 35

1 INTRODUCTION

1.1 SCOPE

1.1.1 This document details mandatory prescriptive and functional requirements relating to the construction of new and, where suitable, modifications to existing buildings and their associated infrastructure on 400kV and 275kV Gas Insulated Switchgear (GIS) substation sites and, where appropriate, Air Insulated Switchgear (AIS) substations. It is a development of, and shall be read in conjunction with, all relevant National Grid standards as appropriate.

1.1.2 For the purposes of this document it is assumed that a GIS or AIS substation comprises one or more of the four distinct groups of buildings described below. These building units shall be used individually or in combination as necessary to achieve the project objectives. Design and configuration shall be as economic as possible whilst achieving the required levels of functionality and durability (i.e. design life). On new build projects all of the building groups may be utilised whilst at existing sites only certain elements may be required to supplement existing facilities as necessary.

1.1.3 These requirements shall **not** necessarily apply to 132kV GIS Substation Buildings (which are generally elevated to facilitate cable entry and have to incorporate third party organisations requirements, for example Distribution Network Operator (DNO) Companies) or multi-storey 400kV and 275kV GIS Substation buildings, for example those constructed in areas prone to flooding. This document shall be supplemented with additional specifications for such installations however wherever practicable the principles contained herein shall be adopted.

1.1.4 Barring the exceptions in 1.1.3 the requirements contained herein shall constitute the design standards for all GIS substation buildings and, where appropriate, the equivalent buildings on AIS substations. Project specific deviations from these principles may be permitted by agreement with National Grid where it can be proven that they offer a better technical, economic and/or lower risk solution. All such deviations shall be fully discussed and agreed within timescales that do not adversely affect any of the project objectives and shall be recorded in the design documentation appropriate to the project contract strategy.

1.1.5 Design work shall comply with all appropriate National Grid Technical Specifications (NGTS's and TS's), Design Handbooks, British Standards, European Standards and Codes of Practice as appropriate and be in accordance with recognised analytical methods. Where the requirements of this document or any other relevant project specifications are in conflict those specifically detailed within this document shall take precedence otherwise national Grid shall be informed and will instruct accordingly..

1.1.6 The four substation building groups are as follows;

a) SWITCH HALL (GIS Substation only)

The primary function of the switch hall building shall be to act as a 'weather shield' for the Gas Insulated Switchgear and other equipment contained therein.

b) ANCILLARY PLANT ROOM BUILDINGS (GIS & AIS Substations)

Comprising individual prefabricated modular buildings housing one or more of each of the following facilities as necessary;

- i. LVAC Supplies/Distribution Room
- ii. Protection Room
- iii. Battery Room
- iv. Telecoms Room
- v. Substation Control System/Permit Room
- vi. Dispersed Relay Room' (or block house)

c) AMENTIES BLOCK (GIS & AIS Substations)

Comprising a single prefabricated modular building containing one or more of the following spaces as necessary;

- i. Entrance Lobby
- ii. Mess Room
- iii. WC
- iv. Disabled WC
- v. General Office
- vi. Shower
- vii. Changing/Locker Room
- viii. Meeting Room

d) STORAGE & WORKSHOP UNITS (GIS & AIS Substations)

Comprising two discrete modified ISO standard steel shipping containers as necessary

- 1.1.7 Guide drawings showing key building layouts plus a photorealistic 3D view of a generic GIS substation designed in accordance with the requirements of this Handbook are included in the appendices.

1.2 GENERAL REQUIREMENTS

- 1.2.1 This document shall be read in conjunction with the appropriate section and latest revision of DH10, 'Electricity Substation Construction - Civil, Structural & Building Design Handbook'.

- 1.2.2 As the works are for a Statutory Undertaker, they are technically exempt from the requirements of the Building Regulations however notwithstanding this or any other exemptions that may be applicable and unless specified to the contrary in this document, all building work shall be in accordance with the appropriate requirements of the Building Regulations. Where literal compliance is not possible the work shall be to an agreed standard that takes the Building Regulations as its basis. Wherever possible specific consideration shall be given to those requirements relating to the health, safety and welfare of people, the conservation of fuel and energy, ease of access and facilities for disabled people and fire safety and means of escape.

INFORMATIVE: With regard to interpreting the Building Regulations and any other relevant legislation the Switch Hall Building is not to be classed as a 'work place'.

- 1.2.3 All building systems shall have a 40 year design life unless noted otherwise. Life to first maintenance shall be 15 years minimum
- 1.2.4 In all instances consultation with the appropriate planning authority in accordance with the Town and
- 1.2.5 Country Planning (General Permitted Development) Order shall be necessary with respect to the external appearance of the building.
- 1.2.6 Glass Reinforced Plastic (GRP) shall NOT be employed as a structural material or component for any substation buildings.
- 1.2.7 Dedicated SF₆ washing facilities shall not be required on outdoor or indoor substation sites provided the control building, or other agreed space, includes a permanent shower/drying room conforming to the following minimum standard;
- i. Room plan dimensions: 1400mm x 2500mm
 - ii. Thermostatic mixer shower unit
 - iii. 1400mm x 900mm stone resin shower tray with side panels to suit
 - iv. Shower area to be tiled or to have pre-finished surfaces

- v. One locker unit plus one bench seat to suit
- vi. Slip resistant vinyl floor covering

INFORMATIVE: Due to the generally physical and potentially hazardous nature of the majority of operational tasks necessary in substations it is considered unsafe and impractical to assign such work to individuals having certain types of disability. Moreover the broad spectrum of conditions covered by the Disability Discrimination Act (DDA) make it unviable to make advance provision for every potential employee. Consequently the Switch Hall, Ancillary Plant Room Buildings, Storage Unit and Workshop Unit shall not be required to include any specific or general provision for disabled users in accordance with the DDA.

Where it is reasonable, and it can be confirmed that they will not endanger themselves or their colleagues, employees with disability may be asked to work in an operational substation environment. In such instances an assessment of the designated place of work will be carried out and the necessary building modifications made retrospectively to facilitate this.

The exception to this will be the Amenities Block which will make general provision for wheelchair users because;

- a) *It is considered more likely that such individuals (both employees and visitors) will use these facilities (for meetings etc), and*
- b) *To retrospectively make such provision would be prohibitive.*

It is assumed that all visitors who are identified as disabled will be escorted by National Grid personnel while on site to ensure they are fully aware of the areas into which they may safely go

- 1.2.8 Where such permanent facility cannot be easily or economically accommodated (for example an existing site where SF₆ containing plant is being installed) an outdoor washdown area shall be provided to facilitate the use of a mobile changing/shower unit. This shall, as a minimum, comprise a rectangular reinforced concrete slab having dimensions of 6m x 4m projecting 50mm above the surrounding finished substation level. The slab shall be laid to minimum falls for drainage purposes with surface water running off to the surrounding areas (unless the site topography and geology dictate a positive drainage system is necessary).
- 1.2.9 The washdown area shall be provided with electricity connections (in accordance with BS EN 60309-2:1999 – 'Plugs, socket-outlets and couplers for industrial purposes. Dimensional interchangeability requirements for pin and contact-tube accessories') and water supplies as follows:
- 1.2.10 1 No 3 phase 32 A integrated isolator/socket including a neutral connection (IP 67 rating)
- 1.2.11 1 No single phase 16A integrated isolator/socket (IP 67 rating)
- 1.2.12 1 No insulated potable water supply with an outdoor tap.
- 1.2.13 A suitable manhole chamber with 5 tonne (minimum) single wheel load solid top cover and frame shall be provided adjacent to the slab to accept waste water discharges from the mobile facility. This shall connect to a foul water sewerage system via a 100mm (minimum) outlet pipe incorporating a trap. Where the site is not connected to mains drainage a cesspool or similar storage unit may be used provided this is not specifically for the purpose of collecting SF₆ waste (to be resolved)
- 1.2.14 Steel reinforcement shall only be used in concrete for structural reasons or to control early thermal cracking. Where alternatives to steel (e.g. fibre reinforced concrete) are proposed a trial area having the same cross sectional area as the proposed permanent works element

shall be constructed on site to demonstrate the efficacy of the methods of batching, delivery, placement, compaction and curing.

- 1.2.15 Where required earthing systems and connections shall be designed in accordance with NGTS 3.1.2, 'Earthing'.
- 1.2.16 All door lock barrels shall be suitable for replacement with National Grid master key barrels.
- 1.2.17 All buildings shall be appropriately sealed to prevent vermin entry. Additionally trench and/or cable entry points shall be designed to facilitate the prevention of water and vermin ingress without compromising the capacity of that system for future cable installation.
- 1.2.18 The external doors (including the vehicular access door) and opening windows of all buildings shall be fitted with intruder detection systems with an audible alarm. There shall be two independent systems, one covering the Amenities Block only with the control panel in that building and one for the Switch Hall and Ancillary Plant Room buildings with the control panel in the Substation Control System/Permit Room.

INFORMATIVE: The principle of the intruder detection and alarm systems shall be such that a visitor to the site may utilise the Amenity Block facilities without compromising the security of the operational buildings.

*INFORMATIVE: The design principles of this document are based on the assumption that at 400kV, cable, transformer or Air Insulated Switchgear (AIS) connections shall be via Gas Insulated Busbar (GIB) tubes through the wall of the Switch Hall building to outdoor sealing ends, bushings or transformer GIB connections and not through a cable basement.
Delete Check*

- 1.2.19 Exposed concrete floors shall be sealed against dust via the application of a chemical, abrasion, stain and slip resistant heavy duty epoxy resin sealer. The colour shall be light grey. RAL No 7035
- 1.2.20 Where the external wall of a building forms part of a substation site boundary – i.e. is not contained within a perimeter security fence – additional measures shall be taken to ensure the level of security at that interface is not less than that of the adjacent substation perimeter security fence(s).
- 1.2.21 Internal guttering and rainwater pipes shall not be permitted.
- 1.2.22 All rooms and areas in which people shall be required to work – either long or short term – and mess room facilities or similar shall have sufficient heating and/or ventilation to provide an acceptable zone of 'thermal comfort' of between 13°C (56°F) and 30°C (86°F) without compromising the operation of any plant or equipment also contained therein.

INFORMATIVE: The term 'thermal comfort' is as used by the Health and Safety Executive specifically in their publication HSG194, 'Thermal comfort in the workplace, Guidance for employers'

1.3 LEGACY REQUIREMENTS

- 1.3.1 The following sections are included for consistency with earlier standards specifically NGTS 2.10, 'Generic Technical Specification for Specification Civil Engineering Works' which has been withdrawn and shall also be used, where appropriate, to support the design principles of this document.

1.3.2 Brickwork and Blockwork

- 1.3.3 Where the underside height of a slab or beam does not coincide with the top of a blockwork course (typically a multiple of 225mm) the residual space may be filled with concrete brickwork to a nominal depth of 75mm, 112mm or 187mm. Where impractical the blockwork shall be cut to size wet, with a mechanical masonry saw.
- 1.3.4 Joint reinforcement of expanded metal 40mm narrower than the width of the wall shall be provided at all positions above and below wall openings in blockwork, extending for a minimum of 600mm either side of the opening to the first and second courses above and below the opening.
- 1.3.5 Gaps in brickwork movement joints shall be filled with an approved flexible jointing material to within 20mm of face, and externally the remaining gap will be primed and sealed using a two part polysulphide sealant in accordance with the manufacturers recommendations. Colour to match brickwork. Hemp, fibreboard, cork and similar materials shall not be used as the filler material.
- 1.3.6 Control joints shall have a minimum width of 10mm filled with mortar to within 20mm of the block face and pointed with an approved two part polysulphide sealant.
- 1.3.7 Edge cover to joint reinforcement in brickwork and blockwork shall be as the table below:

Exposure Condition of the Masonry Brickwork or Blockwork	Type Of Steel Reinforcement	Reinforcement In Mortar Joints Between Bricks or Blocks - Cover to Outer Face of Brickwork or Blockwork
Unprotected	Galvanised to BS 729	Not to be used
	Austenitic stainless	25 mm
Sheltered from severe rain and against freezing whilst saturated with water. Buried masonry and masonry continuously submerged in fresh water	Galvanised to BS 729 and Austenitic stainless	25 mm
Completely protected against weather or aggressive conditions	Galvanised to BS 729 and Austenitic stainless	25 mm

- 1.3.8 Gaps in brickwork movement joints shall be filled with an approved flexible jointing material to within 20mm of face, and externally the remaining gap will be primed and sealed using a two part polysulphide sealant in accordance with the manufacturers recommendations. Colour to match brickwork. Hemp, fibreboard, cork and similar materials shall not be used as the filler material.
- 1.3.9 Control joints shall have a minimum width of 10mm filled with mortar to within 20mm of the block face and pointed with an approved two part polysulphide sealant.

Trussed Rafter Roofs, Felt and Roof Tiles

- 1.3.10 Design and manufacture shall be by a member of the 'Trussed Rafter Scheme' operated by BM TRADA Certification and in accordance with the technical guidance of The Trussed Rafter Association and BS EN 1995-1-1:2004 + Amendment 1:2008 Eurocode 5, 'Design of timber structures. General. Common rules and rules for buildings'.
- 1.3.11 The design shall assume a minimum breadth of 44mm for all members for calculation purposes with a maximum breadth of 47mm on drawings to allow for tolerances

- 1.3.12 Fasteners shall be assumed to transmit all loads ignoring the effect of end bearing timber and make allowance for a gap of 1.5mm between adjacent members
- 1.3.13 Ungraded softwood for battens to plain tile roofing shall be in accordance with the following table;

COVERING	SPAN (mm)	SIZE (mm)
Plain Tiles		
a. pitched tiling	450	32 x 19
b. pitched tiling	600	32 x 25
c. vertical tiling	450	38 x 19
d. vertical tiling	600	38 x 25
Single Lap Tiles		
a. pitched tiling	450	38 x 22
b. pitched tiling	600	38 x 25

- 1.3.14 The service life for timber treatment shall be 50 years
- 1.3.15 Truss clips shall be galvanised mild steel
- 1.3.16 Punched metal plate fasteners shall be galvanised plain sheet or coil.
- 1.3.17 Tie-Down Straps shall be galvanised mild steel not less than 30mm x 2.5mm cross section with 100mm cranked end and 1000mm long. They shall be positioned at not more than 2.0m centres with not less than two nails/screws per strap.
- 1.3.18 Lateral restraint straps shall be galvanised mild steel not less than 30 x 5mm cross section with 150mm cranked end and of sufficient length to pass over 3 no. joists or rafters. They shall be at maximum centres of 1.25m.
- 1.3.19 Concrete roof tiles and fittings shall be double lap (non-interlocking) or single lap (interlocking) in accordance with BS EN 491:1994, 'Concrete roofing tiles and fittings. Test methods' and BS EN 490:1994, 'Concrete roofing tiles and fittings. Product specifications'.
- 1.3.20 Mortar for roof tiling shall be in accordance with BS 5534:2003 + A1:2010, 'Code of Practice for Slating and Tiling (Including Shingles)'.
- 1.3.21 Continuous stepped flashings shall be formed at junctions of pitched roofs with brickwork. The upstand shall be lapped by a minimum of 100mm and the bottom edge secured with tacks at 600 mm centres
- 1.3.22 Lead slates, flashings, collars, ridge saddles at abutments and intersections shall be formed with Code 4 lead
- 1.3.23 Roof space ventilation shall be provided at eaves level equivalent to a 10mm unobstructed continuous air gap for roof pitches over 15°
- 1.3.24 Where roof pitches are under 15° ventilation shall be provided at eaves level equivalent to a 25mm unobstructed continuous air gap or such greater figure equal to a total ventilation area of not less than 0.6% of the roof area.
- 1.3.25 Where insulation follows the pitch of the roof, ventilation shall additionally be provided at the ridge equivalent to a continuous 5mm strip.
- 1.3.26 Where a pitched roof has a single slope and abuts a wall, ventilation shall additionally be provided at high level equivalent to a continuous 5mm strip.

Carpentry and Joinery

- 1.3.27 All softwood shall be finished sawn. Sizes not in accordance with BS EN 1313-1:2010, 'Round and sawn timber. Permitted deviations and preferred sizes. Softwood sawn timber' shall be sawn from appropriate larger sizes.
- 1.3.28 Hardwood sizes shall be as defined in BS EN 1313-2:1999, 'Round and sawn timber. Permitted deviations and preferred sizes. Hardwood sawn timber'.
- 1.3.29 All ferrous metalwork, nails, screws, bolts and other mechanical fastenings shall be protected by galvanising or suitable plating for all external work, work in areas of high humidity or corrosive conditions.
- 1.3.30 Adhesives shall be in accordance with the recommendations in Tables 1 and 2 of BS 5442-3:1979, 'Classification of adhesives for construction. Adhesives for use with wood'
- 1.3.31 Nails shall be round wire, annular ringed shank or helical threaded shank to BS 1202-1:2002, 'Specification for nails. Steel nails'
- 1.3.32 Wood screws shall be of steel, brass or stainless steel to BS 1210:1963, 'Specification for wood screws' with slotted countersunk heads as described in Table 1. Brass or stainless steel shall be used for hardwood or clear-finished work.
- 1.3.33 Hexagon bolts and nuts for timber/timber or for timber/metal connections shall be to BS EN ISO 4016:2001, 'Hexagon head bolts. Product grade C' and BS EN ISO 4034:2001, 'Hexagon nuts. Product grade C'
- 1.3.34 Straps shall be of galvanised pre-drilled factory made steel not less than 2.5mm x 30mm in section.
- 1.3.35 Joints and bearings shall be designed and constructed in a manner that maintains all surfaces in full contact. Any joint subject to tension shall be made to resist the load as appropriate to its function.
- 1.3.36 Unless specified structural timbers shall not be cut, notched or modified.
- 1.3.37 All joints shall be nailed, screwed, bolted or jointed. Glued site joints shall not be permitted.
- 1.3.38 Nails shall be driven on the slant so that the connection does not loosen under load. Splitting of timber by nailing shall be avoided by sensible spacing and, where necessary, pre-drilling not in excess of three-quarter nail diameter.
- 1.3.39 Masonry nails shall not be detailed
- 1.3.40 Straps and anchors shall be fixed at each timber contact point with a minimum of two galvanised screws. Straps shall span at least two members when strapping joists and rafters. Any gaps between timber members and masonry shall be blocked when strapping to masonry. Any strap taken into a cavity wall shall be turned down tight against the inner skin for an adequate distance.
- 1.3.41 Joist hangers shall be screw-to-wall type
- 1.3.42 The trimmers at openings shall be aligned with upper and lower surfaces and shall be fitted tightly using joist hangers. Loads shall be transmitted to other solid structures.
- 1.3.43 Joists shall use regularised timber to ensure level supports for floors and linings, etc.

- 1.3.44 Framework for laminated panels shall be designed to allow fixings at 70mm from the edge of each panel and to allow a gap of 5 mm between panels or between an end panel and wall finish.
- 1.3.45 Surface finishes shall be as described in Appendix A of BS 1186-2:1988, 'Timber for and workmanship in joinery. Specification for workmanship'. All exposed timber faces shall be 'WROT'
- 1.3.46 Where a 'natural' finish for staining, polishing or clear varnishing is required, timber in adjacent faces shall be matched to be uniform or symmetrical in colour and grain.
- 1.3.47 Nails shall only be used in areas to be painted.
- 1.3.48 Screws in hardwood other than for fixing ironmongery, shall be countersunk, pelleted or, if removable, cupped.
- 1.3.49 Removable duct panels shall be of either blockboard, plywood or a proprietary laminated board. The edges shall be lipped with hardwood when specified.

Sanitary and Plumbing Installations

INFORMATIVE: Current legislation demands the inclusion of a sustainability statement with planning applications. For more remote sites the use of composting WC's may be useful in supporting such submissions as appropriate. Other considerations are;

- Water conservation
- 'Grey water' collection
- Proximity sensors
- Waterless urinals
- Wash basin flow restrictors on taps
- Pre-plumbed panel systems

- 1.3.50 Design shall be in accordance with BS 6700:2006+A1:2009, BS EN 806-2:2005, BS EN 806, 'Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages'
- 1.3.51 Flushing pipes shall be white enamelled steel, plastics or copper, self finished, painted or chromium plated.
- 1.3.52 Basins (ablution and hand) shall be mounted using fishplates, wall hangers, bolts or cast iron brackets. Central leg supports shall be provided where light wall construction or heavy usage of basins is identified.
- 1.3.53 Washing sinks shall be finished in white nylon, vitreous enamel or other approved finish. Where the wall is of light construction, stainless steel leg and strap supports shall be provided.
- 1.3.54 Drinking fountains shall be finished in white porcelain, enamel or nylon.
- 1.3.55 Floor drainage gullies shall be of cast iron or stainless steel (304 Grade) with gratings of stainless steel, polypropylene or equal approved material secured with stainless steel screws.
- 1.3.56 Hot and cold water service branches to ranges of sanitary fittings, or branches to individual fittings, shall be provided with ball type isolating valves fitted as close as practicable to the fittings served.

1.3.57 Wherever practicable overflow and warning pipes shall discharge externally. Where internal discharge is unavoidable this shall be over a suitable floor drainage gully. In either instance outlets shall be configured in such a way and sited in a conspicuous position to ensure they may be easily inspected and maintained.

1.3.58 **Plastering, Rendering and Dry Lining**

1.3.59 Gypsum plasterboards for use as base boards and drylining wall-boards shall be of the following types:

- i. square or round edges baseboard
- ii. fire resisting baseboard
- iii. thermal baseboard with polystyrene layer to BS 3837-1:2004, 'Expanded polystyrene boards. Boards and blocks manufactured from expandable beads. Requirements and test methods'
- iv. vapour check baseboard with metallised polyester foil
- v. vapour check thermal baseboard with vapour resistant membrane

1.3.60 Dry lined partitions shall be framed with proprietary systems

1.3.61 Plaster stops or steel lathing shall be used at junctions between dissimilar backgrounds which are to receive plaster.

Suspended Ceilings

1.3.62 As a minimum drawings shall show the following information:

- i. Reflected ceiling plan with direction of pattern.
- ii. Setting out dimensions for installation and future maintenance with full allowance made to accommodate light fittings, ventilation grilles, fire protection and detection points etc, location of hangers, primary and secondary support members, access facilities, any structural connections.
- iii. Panel joint details.
- iv. Changes in ceiling level and cavity barriers.

1.3.63 The design shall include manufacturer's full supporting technical literature, certificates of fire resistance rating and flame spread classification of testing organisation, certificate of sound absorption coefficients to BS EN ISO 354:2003, 'Acoustics. Measurement of sound absorption in a reverberation room'.

1.3.64 Fire resistance rating shall be a minimum of 2 hours for stability, integrity and insulation as determined in accordance with the requirements of BS 476-22:1987, 'Fire tests on building materials and structures. Methods for determination of the fire resistance of non-load bearing elements of construction'

1.3.65 Flame spread classification shall be Class 'O' as determined by the large scale test conducted in accordance with the requirements of 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'.

1.3.66 The suspension ceiling system shall be of the exposed grid type, and shall include all fixings such as rods, brackets, bracing, hangers, perimeters, connections and accessories designed to form an integrated and rigid framework in two horizontal directions.

1.3.67 All members shall be of galvanised steel. Exposed flanges and trims shall be shop finished to a specified colour.

- 1.3.68 Hold-down clips, connectors and fasteners shall be in accordance with the ceiling manufacturer's recommendations.
- 1.3.69 The main horizontal suspension members shall comprise channel sections in accordance with the ceiling manufacturer's recommendations. Joints between members shall comprise back to back channels with an overlap of approximately 400 mm and with a hanger support wire fixed at the mid-point of the junction. Metal tees for supporting the tiles shall be located immediately below the main horizontal support members.
- 1.3.70 Perimeter edge support shall be of steel or aluminium angle. Angle size shall be approximately 50mm (vertical edge) x 37mm (horizontal edge).
- 1.3.71 Hanger fixing centres shall not be greater than 1200mm.
- 1.3.72 Fixings for edge support angles shall be either:
- a) Fixed directly to softwood grounds approximately 50mm x 18mm, i.e. with the face approximately 5mm proud of the face of a plaster finish. The 5mm gap shall be caulked using a one part polysulphide based sealant.
 - b) Fixed directly to softwood grounds approximately 50mm x 50mm wide with the bottom face WROT and painted black.
- 1.3.73 Tile fixings shall facilitate full access
- 1.3.74 Cavity fire barriers shall be installed vertically in voids above ceilings at not more than 20 metres spacing in any direction unless agreed otherwise following consultation with the local Fire Authority.

Floor Tiling

- 1.3.75 Surface hardeners shall be sodium silicate to BS 3984:1982, 'Specification for sodium silicates'.
- 1.3.76 Mastic asphalt shall be to either BS 6925:1988, 'Specification for mastic asphalt for building and civil engineering (limestone aggregate)' or BS 6577:1985, 'Specification for mastic asphalt for building (natural rock asphalt aggregate)'
- 1.3.77 Isolating membranes for asphalt floors shall be either:
- a) resin-coated glass fibre tissue
 - b) bituminised sheathing felt to BS EN 13707:2004+A2:2009, 'Flexible sheets for waterproofing. Reinforced bitumen sheets for roof waterproofing. Definitions and characteristics'
- 1.3.78 The bay size for unbonded construction shall be limited to 10m² for thicknesses below 100 mm. For thicknesses 100mm or above the topping may be laid in strips not exceeding 4.5m wide and transverse butt joints formed at 10m and 6m maximum spacing for reinforced and unreinforced toppings respectively.
- 1.3.79 The thickness of the screed/topping on in situ concrete slabs shall be between 20mm and 40mm. On precast concrete units the topping shall be at least 100mm thick.
- 1.3.80 The bay size for bonded construction shall be limited to 20m² for topping/screed thicknesses between 20 and 30mm, and 15m² for thicknesses greater than 30mm. The length to width ratio shall not exceed 1.5.
- 1.3.81 The thickness of monolithic cement/sand screeds, concrete and granolithic toppings shall not be less than 12mm nor greater than 20mm. Bay sizes shall be consistent with those used for forming the base concrete.

- 1.3.82 Solid Tiles shall be bedded either:
- in mortar on a separating layer
 - in mortar bonded to the base
 - with bonding adhesive
- 1.3.83 Bedding mortar shall be laid to a depth not less than 15mm of more than 40mm. The mortar shall be thoroughly consolidated and screeded to the required level using screeding rules no more than 750-900 mm apart.
- 1.3.84 Where necessary a separating layer shall be laid loose with minimum laps of 100 mm and overlaid by the cement/sand bedding mortar.
- 1.3.85 In areas where chemical resistance is not required a grout/doping coat shall be poured onto the bedding mortar to a uniform depth of 3mm
- 1.3.86 Coved skirting shall be bedded, jointed and pointed in the same manner as the tiles and with joints aligning with the floor tiling joints.
- 1.3.87 Expansion joints will be made at all junctions, between floor tiles and skirtings, walls, gullies and other floor finishes and at intervals not exceeding 4500mm centres in both directions, and directly over expansion joints in the structural concrete and supporting walls and beams in suspended floors.
- 1.3.88 Expansion joints shall be 10mm wide taken down to the surface of the damp proof membrane or concrete slab as appropriate. The joint filler shall be expanded neoprene strips, taken within 10mm of the final surface of the tiles and the final 10mm of the expansion joints filled with a suitable polysulphide filler
- 1.3.89 Plastic tiles and sheet flooring shall be set out and laid with continuous in-line joints
- 1.3.90 Where bays in mastic asphalt floors exceed 100 m² they shall be constructed alternately

Raised Access Floors

- 1.3.91 Raised Access Flooring shall be a proprietary system designed in accordance with BS EN 12825:2001, 'Raised Access Floors' and PSA (Property Services Agency) MOB PF2 PS/SPU.
- 1.3.92 Drawings shall include, as a minimum, the following information:
- a) Layout plans of each floor showing the positions of all access floor pedestals and clearly showing the setting out point.
 - b) Co-ordination with service runs and the extent of any required 'bridging'.
 - c) Positions of any required service penetrations/outlets in the panels.
 - d) Position of any fixed furniture and heavy equipment.
- 1.3.93 The surface of panels within the void must be Class 0 as defined in Approved Document B Table A8 of the Building Regulations and Class 1 with an Index of Performance (1) not exceeding 12 and a Sub Index (i) not exceeding 6 when tested in accordance with BS 476-6:1989+A1:2009, 'Fire tests on building materials and structures. Method of test for fire propagation for products'
- 1.3.94 There shall be a mechanically produced recess at each of the four corners of the underside of the panel to provide a positive location at the support point of each pedestal head. The steel tray shall not be broken at this point, i.e. drilled holes will not be acceptable for the recess.
- 1.3.95 The first preference dimensional grid of the supporting pedestals shall be of a co-ordinating size of 600mm x 600mm.