Building Technology Research Institute
香港建築科技研究院
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BTRi Product Specification for Building

2025 Edition

BTRi Product Specification for Building (BPS-B)

(This Version is Continuously Updated to include Amendments issued)

This Electronic File has incorporated the following Amendments:-

Rev	Issue Date	Amendment Incorporated
First Issue	29 September 2025	-

FOREWORD

The BTRi Product Specification for Building (BPS-B) lays down the quality of materials for building undertaken for the Construction Products Accreditation Scheme (CPAS).

The First Edition of the BPS-B comprises mainly the standards and requirements of construction products making reference to the General Specification for Building, 2022 Edition issued by Architectural Services Department (ArchSD) and particular specifications of major building projects. It was produced under the guidance of the CPAS Technical Committee comprising members from the academia and consultants in the engineering industry.

The BTRi Product Specification for Building will be updated continuously. The electronic files of the sections affected by any amendment issued will be kept up-to-date on CPAS Portal.

NOTES

Clauses of the BPS-B generally follow the naming and numbering of the General Specification (GS) for Building, 2022 Edition. BPS-B includes clauses that define the technical standards of construction products and excludes/ strikethrough clauses on workmanship, on-site testing or project specific requirements that would not be considered at material approval stage. Additional clauses referenced from particular specifications of public works projects are marked with "*".

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BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 1

PRELIMINARIES

SECTION 1
PRELIMINARIES

Abbreviations **1.3** Abbreviations used shall have the following meanings:

(a) Common terms:

BS	British Standard
BS EN	European Standard
CP	Code of Practice
CS	Construction Standard
GS	General Specification for Building
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization Publication
PS	Particular Specification
PW	Public Works
SO	Supervising Officer
DEVB List	Development Bureau current enforced List of Approved Suppliers of Materials and Specialist Contractors for Public Works

(b) Units:

°	degree
°C	degrees Celsius
cm	centimetre
cm2	square centimetre
g	gram
g/m2	gram(s) per square metre
ha	hectare
hr	hour
kg	kilogram
kg/m2	kilogram(s) per square metre
kg/m3	kilogram(s) per cubic metre
km	kilometre
km/hr	kilometre(s) per hour
kN	kiloNewton
kN/m	kiloNewton(s) per metre
kN/m2	kiloNewton(s) per square metre
kPa	kiloPascal
L	litre
L/min	litre(s) per minute
L/min/m2	litre(s) per minute per square metre
L/m2	litre(s) per square metre
L/m2/s	litre(s) per square metre per second
m	metre
m2	square metre
m3	cubic metre
m/s	metre(s) per second
m2/kg	square metre(s) per kilogram
m2/L	square metre(s) per litre
m3/hr/m	cubic metre(s) per hour per metre
m3/hr/m2	cubic metre(s) per hour per square metre
Mg	megagram
Mg/L	megagram(s) per litre
min	minute
mL	millilitre
mm	millimetre

mm2	square millimetre
mm3	cubic millimetre
mm/hr	millimetre(s) per hour
mm/s	millimetre(s) per second
MPa	megaPascal
N	Newton
Nm	Newton metre
N/cm2	Newton(s) per square centimetre
N/mm	Newton(s) per millimetre
N/mm2	Newton(s) per square millimetre
No.	number
RH	relative humidity
s	second
t	tonne
µm	micrometre (micron)
µW	microwatt(s)
µW/cm2	microwatt(s) per square centimetre
w/m °C	watt(s) per metre per degree Celsius
%	percentage
% m/m	percentage by mass

British Standards, European Standards and Codes of Practice

1.8 "British Standards", "European Standards" and "Codes of Practice" shall be deemed to include all amendments, revisions and standards superseding the standards listed herein, current and published before the date of first tender invitation for the Contract unless otherwise specified. In the case of Sections 1, 3, 5, 6, 7, 8, 15, 25 and 26, the stated editions of BS, BS EN, CP and similar standards are to take preference over any later amendments, revisions or standards superseding the standard. For the Codes of Practice and Construction Standards issued by the Government of Hong Kong, the latest editions shall apply unless otherwise specified. Equivalent International Standards may be used if approved by the SO.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 3

EXCAVATION AND EARTHWORK

SECTION 3
EXCAVATION AND EARTHWORK

Soil-cement **3.27**

(a) Soil-cement shall consist of Portland Cement (PC), sand and inorganic soil in the proportions 1:3:12 by mass.

(b) PC shall comply with Clause 6.27.

(c) Sand shall be natural sand or crushed natural stone complying with **BS 1200:2019**.

(d) Inorganic soil shall be free from organic matter and shall contain no more than 30% of soil particles passing a 63 μm BS test sieve.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 4

STEEL SHEET PILING WORK

SECTION 4
STEEL SHEET PILING WORK

Steel sheet pile sections **4.1**

Steel sheet piles shall be weldable structural steel to **BS EN 10248-1** Grade S270GP unless otherwise agreed by the SO.

Steelwork and accessories for use in the system of lateral support shall be as Section 15 - Structural Steel Work**.**

Testing of steel sections and accessories shall be as Section 15 - Structural Steel Work.

Fabricate special and non-standard sheet piles including corner piles and junction piles from sheet pile sections approved for use in the Works.

Provide sheet piles in single continuous lengths unless otherwise specified.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 5

PILING WORK

SECTION 5
PILING WORK

Steel 'H' piles **5.18**

(a) Steel sections must comply with the requirement of **BS EN 10025-1:2004** & **BS EN 10025-2:2004** Grade S275, S355JR or S450J0.

~~(b) Use steel sections with flange and web thicknesses not less than 20 mm.~~

~~(c) Testing of steel sections and accessories shall be as Section 15 – Structural Steel Work.~~

~~(d) Notwithstanding Clause 5.18 (c), for every one hundred segments or part thereof of each section of same thickness from the same cast, one segment shall be selected at random on the Site by the SO for testing. Provide two test specimens taken at both ends of each of the chosen segment. For the purpose of this clause, "same thickness" means similar sections with a variation in thickness not exceeding +5 mm, and "segment" means every length of pile as rolled.~~

~~Prepare the test specimens to **BS EN 10002-1** as directed and appropriately label, mark and deliver them to the Public Works Laboratories (PWL), as directed by the SO.~~

~~(e) The energy of the hammer should be so chosen such that the pile will not be damaged during driving. As a minimum requirement, the Contractor shall demonstrate with DPT that driving stresses would not exceed 0.9 f_y.~~

~~(f) Carry out splicing to increase the length of steel "H" piles in accordance with the details shown at Annex "B". Unless agreed by the SO, the minimum length of each steel H pile section shall be 10 m except the uppermost section. Construct joints to maintain the true alignment of the pile section. Welds shall be subject to the following examination:~~

~~(i) All welds shall be visually inspected to **BS EN ISO 17637**.~~

~~(ii) 10% of the welded joints shall be subjected to ultrasonic examination to **BS EN ISO 17640** Level B and magnetic particle inspection to **BS EN ISO 17638.**~~

~~There is no limit on hold time for the examination, except that the initial 2 butt welded joints shall be examined by non destructive tests after 40 hr. Joints to be tested shall be selected by the SO. The standard of acceptance for welds shall be in accordance with Table 14.3b in the **Code of Practice for the Structural Use of Steel** issued by the Buildings Department.~~

~~Employ an Accredited Laboratory to carry out and interpret the inspection and testing of welds, and provide any necessary labour and attendance. The Accredited Laboratory shall submit the HOKLAS endorsed test reports directly to the SO in sealed envelopes within 3 days of the completion of the testing. Tests revealing discontinuity shall be reported separately for the subsequent repair and re-test.~~

~~(g) Provide capping plates and dowel bars in accordance with the details shown at Annex "C".~~

~~(h) Unless otherwise specified, inspection and testing of welding, other than those shown on the typical splicing details and pile head details shown in Annexes "B" and "C", shall be in accordance with Clause 15.58.~~

~~(i) Pile of same size but of different grades shall not be used in the same site.~~

~~(j) If Hiley Formula is used to calculate the allowable load capacity of steel 'H' pile, the temporary compression of the hammer cushion (Cc) shall be taken~~

~~as not less than 5 mm when plastic cushion of 200 mm thickness or less is used.~~

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 6

STRUCTUREAL CONCRETE WORK

SECTION 6
STRUCTURAL CONCRETE WORK

Props & bracings	**6.4**	(a)	Props shall be to **BS EN 1065:1999**. No timber props and bracings shall be permitted.
Formwork		(b)	Formwork shall be timber or moulds of other materials against which the concrete is cast.
		(c)	Formwork shall not be split, or have other defects such as cracks.
Formwork ties		(d)	Formwork ties shall be of a removable type.
		(e)	In waterproof concrete, any tie through the concrete shall be of a type with a baffle and shall leave no holes in the concrete.
Surface retarders		(f)	Surface retarders shall be of a type which shall not stain or colour the concrete.
Release agents		(g)	Release agents used on formwork for structures containing potable water shall be non-toxic and shall not impart a taste to the water.
		(h)	Release agents containing mineral oil shall not be used. These include barrier paint, polyurethane varnish, or wax.
		(i)	Release agent used on steel formwork shall contain a rust-inhibiting agent.
Void formers		(j)	Polystyrene shall not be used as void formers and box-out material unless permitted by the SO.
Wood preservatives		(k)	Wood preservatives in permanent timber formwork shall be to Clause 21.30.

REINFORCEMENT

Steel reinforcement	**6.14**	Steel reinforcement shall be ~~plain steel reinforcing bars or ribbed steel reinforcing bars to **CS2 or**~~ steel fabric to **BS 4483:2005**. Cold reduced steel wire used for the manufacture of steel fabric shall be to **BS 4482:2005**.
	6.14A*	steel reinforcement shall be plain steel reinforcing bars (denoted by R) or Grade 500B ribbed steel reinforcing bars (denoted by T) to Construction Standard CS2.

REINFORCEMENT (EPOXY COATED)

Cover spacers	**6.22**	Provide sufficient cover spacers of the following types to support reinforcement in position: (a) Concrete blocks of similar quality to that of the surrounding concrete. (b) Plastic or other approved proprietary type. Cover spacers shall be capable of supporting the weight of reinforcement and construction load without breaking, deforming or overturning.
Reinforcement connectors	**6.24**	Reinforcement connectors shall be of a proprietary type approved by the SO and shall be used strictly in accordance with the manufacturer's instructions unless otherwise specified.

Mechanical Couplers	**6.24A***	(1) Mechanical couplers are classified as type 1 mechanical couplers, that conforms to clause 3.2.8.3 of the Code of Practice for Structural Use of Concrete 2013 (CoP2013), and type 2 mechanical couplers, that conforms to clause 3.2.8.4 of CoP2013 (2) Mechanical coupler shall be of an approved proprietary type comprising threaded or cold swaged metal sleeve that can transfer full tension and/or compression strength of the connecting steel reinforcing bars by means of mechanical interlocking between the sleeve and the connecting bar. (3) Mechanical couplers of welded or grouted sleeve shall not be used.
Epoxy coatings to reinforcement	**6.25A**	Epoxy coatings to reinforcement and patching materials for epoxy coatings shall comply with **BS 7295-1:1990** and **BS 7295-2:1990** except as stated in Clauses 6.25H, 6.25J, 6.25K and 6.25L hereinafter. The coatings shall be applied by the electrostatic spray method in accordance with **BS 7295-1:1990**.
Chairs, supports and spacers	**6.25B**	Chairs, supports and spacers other than cover spacers for reinforcement shall be steel. The steel shall be coated with nylon, epoxy, plastic or other dielectric material for epoxy coated reinforcement.
Tying wire	**6.25C**	Tying wire for epoxy coated reinforcement shall be 1.6 mm diameter soft annealed steel wire coated with nylon, epoxy, plastic or other dielectric material.

CONCRETE

Cement	**6.27**	Portland cement shall be to **BS EN 197-1:2011** (Type CEM I). Strength Class of cement used in structural concrete shall be 52.5 N, unless otherwise approved by the SO. Sulphate-resisting Portland cement shall be to **BS 4027:1996**. High alumina cement shall not be used in structural concrete.
PFA	**6.28**	Pulverized-fuel ash (PFA) shall conform to either **BS 3892-1:1997** with the following modifications: (a) Use Portland cement CEM I (strength class 52.5 N) to **BS EN 197-1:2011** to determine water requirement, strength factor at 28 days, soundness and initial setting time. (b) The criteria for water requirement and strength factor at 28 days shall not apply, but the values as determined shall be stated in the certificates for submission. (c) PFA shall contain up to 10% total lime content or high lime PFA shall contain up to 20% total lime content and with soundness value not more than 10 mm. or **BS EN 450-1:2012** with the following requirements: (a) The loss on ignition shall be either Category A or B. (b) The fineness of Category N PFA, if used, shall be declared.
PFAC	**6.29**	Portland-fly ash cement (PFAC) shall be to **BS EN 197-1:2011** (Type CEM II/A-V and CEM II/B-V). Strength Class of cement used in structural concrete shall be 42.5 N or higher, unless otherwise approved by the SO.
CSF	**6.29A**	Condensed Silica Fume (CSF) shall be to **CSA-A23.5 M86** (Canadian Standard) or **BS EN 13263-1:2005+A1:2009**.
GGBS	**6.29B**	Ground Granulated Blast Furnace Slag (GGBS) shall be to **BS EN 15167-1: 2006** except that the scheme for the evaluation of conformity of GGBS specified in **BS EN 15167-2:2006** is not required. The glass content as determined by X-ray

diffraction or optical-microscopy method shall be not less than 67%. The X-ray diffraction method detailed in Appendix D of **BS 6699:1992** is acceptable.

Aggregates **6.33** Aggregates shall be obtained from a source approved by the SO. Aggregates from marine source and all-in aggregates shall not be used.

Coarse aggregate shall consist of clean, hard and durable crushed rock complying with **CS3**.

Fine aggregate shall consist of clean, hard and durable crushed rock complying with **CS3**. Natural sand shall not be used in production of concrete unless otherwise agreed by the SO.

The flakiness index of coarse natural aggregates, when determined to **CS3** shall not exceed 30.

The potential alkali-reactivity category of coarse aggregate and fine aggregate shall be determined from the results of tests on potential alkali-reactivity of aggregates using the test method given in CS1. Aggregates in the "Reactive" category shall not be used unless with the prior approval of the SO.

Unless otherwise specified in the Contract, Sub-section 4.2.1 of **CS3** on Los Angeles value shall not be required for aggregates.

6.33A* aggregates for concrete shall be clean, hard and durable crushed rock to Construction Standard CS3 (CS3)

Water **6.35** Water for concreting shall be clean and uncontaminated potable water from Government main supply or any other approved source. If taken from a source other than Government main supply, it shall be tested in accordance with **BS EN 1008:2002** when required by the SO.

Wash water from concrete mixer washout operations (recycled water) may be used for mixing concrete of grade strength not exceeding 35 MPa provided that :

(a) The density of recycled water in the combined water (comprising tap water and recycled water) does not exceed 1030 kg/m^3.

(b) The 28-day strength of test cubes with combined water shall not fall below 90% of control test cubes made with tap water.

(c) The chemical limits of the combined water shall not exceed those in Table 6.12.

(d) Tests shall be conducted in accordance with Table 6.12.

Admixtures and additives **6.36** Submit the following details of any admixtures or cement containing additives for approval before using:

(a) Brand name and manufacturer's literature.

(b) Proposed dosage and detrimental effects, if any, of underdosage and overdosage.

(c) The chloride content which shall not exceed 2% by mass of the admixture or 0.03% by mass of the cementitious content as required in Clause 6.40.

(d) Method of adding to the concrete mix.

Pigments for colouring cement and concrete shall comply with **BS EN 12878:2014**.

Accelerators, retarders, normal water-reducing, superplasticizing admixtures and combinations of these shall comply with **BS EN 934-2:2009+A1:2012**.

~~When the use of admixtures or cement containing additives is approved or specified, use strictly in accordance with the manufacturer's instructions and at approved dosage levels.~~

~~Store admixtures in watertight weatherproof containers clearly marked to show the contents.~~

Admixtures for Concrete for Sea Water Containing Structure **6.36A*** Superplasticising admixtures shall comply with BS 5075: Part 3 or BS EN 934-2.

Concrete curing compound **6.37** The curing compound shall, when applied by a mechanical sprayer, become stable and impervious to evaporation of water from the concrete surface within 60 min of application. It shall not react chemically with the concrete to be cured and shall not crack, peel or disintegrate within one week after application.

Concrete curing compound for structures shall be a liquid resin or wax-resin base membrane curing compound of an approved proprietary brand. It shall have a minimum curing efficiency of 85% and shall contain a fugitive dye. The curing compound shall degrade completely within 3 weeks after application and the concrete surface so treated shall not impair the bonding of applied finishes.

Concrete curing compound for carriageways shall be a non-pigmented liquid resin or wax-resin base membrane curing compound of a proprietary brand. It shall achieve a 96% efficiency index and shall be available both with or without a fugitive dye.

Submit the following details of the curing compound for approval before using:

(a) Brand name and manufacturer's literature.

(b) Method of application.

(c) Recommended rate of application.

(d) Test certificates, prepared by an approved testing laboratory, to show that the curing compound will provide the required curing efficiency.

MOVEMENT JOINTS

Materials **6.61** Water stops shall be an approved proprietary make with prefabricated angle and intersection pieces.

Impregnated fiberboard joint filler for roads, pavings etc. shall be an approved proprietary make.

Inorganic joint fillers, bond breakers and back-up material shall be an approved proprietary make in either sheet form, strip or cord sections.

Sealants shall be approved proprietary make and shall contain no more than 0.01% and 0.5% by wet weight of formaldehyde and total aromatic compounds (including benzene, toluene, xylenes, and ethylbenzene, etc.) respectively.

Hot applied joint sealants for concrete pavements shall be to **BS 2499-1:1993; BS 2499-2:1992; BS 2499-3:1993,** Type N1.

Cold poured joint sealants for concrete pavements shall be to **BS 5212-1:1990; BS 5212-2:1990; BS 5212-3:1990**.

Two-part polysulphide-based sealants shall be to **BS 4254:1983.**

One-part gun-grade polysulphide-based sealants shall be to **BS 5215:1986.**

~~Mechanical expansion joints shall be obtained from one of the specialists included in the Development Bureau List for Supply and Installation of Expansion Joints for Highway Structures.~~

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 7

PRESTRESSED CONCRETE WORK

SECTION 7
PRESTRESSED CONCRETE WORK

CONCRETE

Concrete **7.4** All concrete work shall be in accordance with Section 6 of the GS.

GROUT

Material **7.5** Cement shall be Portland Cement.

Admixture shall be approved by the SO and shall contain no chloride, nitrate, sulphate, or aluminium powder.

Properties **7.6** Grouts shall be non-shrink, low bleeding in the plastic state and be fluid.

Tests for bleeding or grout settlement shall be made at ambient temperature on 100 mm deep samples contained in 100 mm diameter airtight vessels. The upper surface of the cement particulars shall not settle more than 2 mm after 3 hr or 4 mm maximum. Any water separated at the surface shall be re-absorbed within 24 hr.

Tests for fluidity shall be by the measurement of the time for L of grout to flow from a funnel or flow cone. A flow cone with a 10 mm outlet pipe with a water outflow time of 5 s may be used. With this cone, grouts shall have the outflow times between 12 s to 25 s.

Mix proportions of grout **7.7** Water/Cement ratio shall not exceed 0.4.

Quantity of sand/filler used shall not exceed 30% of the mass of cement.

Admixtures shall be used as recommended by the manufacturer and shall be free of any chemical liable to promote corrosion of the tendon or cause damage to the grout.

If gas-producing expanding agents are used, the total unrestrained expansion shall not exceed 10% at ambient temperature.

Chlorides from all sources, i.e. cement, water, sand, filler and admixture shall not exceed 0.1% by mass of the cement.

PRESTRESSING TENDONS

Prestressing Tendons **7.9** Low relaxation prestressing tendon shall be as follows, unless otherwise specified:

(a) Round cold drawn high tensile single steel wire to **BS 5896:1980** with plain finish.

(b) Seven wire steel strand to comply with **BS 5896:1980**.

(c) High tensile steel bars to **BS 4486:1980** comprising open hearth steel with sulphur and phosphorous contents each below 0.05%.

All wire and strand shall be in the stress-released or stabilised condition.

DUCTS

Ducts **7.18** Ducts for prestressing tendons shall be an approved proprietary type with permanent sheathing or extractable core. All ducts shall be:

(a) Strong enough to withstand all forces acting on them during construction.

(b) Impervious, to prevent penetration of laitance which might subsequently hinder the movement of the tendons.

(c) Rigidly supported at 450 mm centres maximum.

Sheathing **7.19** Provide sheathing with a profile that gives a strong bond with the outside concrete and inside grout but does not cause undue friction or resistance to the tendons during stressing.

Keep joints to the minimum practicable. Joints shall be formed using sleeve connectors, adequately sealed against ingress of any material. Stagger joints in adjacent sheathings by 300 mm minimum.

ANCHORAGES

Anchorages **7.22** Anchorages shall be of an approved proprietary type to **BS EN 13391:2004**, capable of distributing the stress evenly in the end blocks. Anchorages shall maintain the prestressing force under both sustained and fluctuating loads and be able to withstand the effect of external shock with minimum movement of the tendon.

Clean all bearing surfaces of the anchorage prior to concreting and tensioning.

Provision shall be made for the protection of anchorages against corrosion.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 9

BRICKWORK AND BLOCKWORK

SECTION 9
BRICKWORK AND BLOCKWORK

Generally **9.1** Brickwork and blockwork to be in accordance with **PD 6697, BS EN 1996-1-2, BS EN 1996-2** and **BS EN 1996-3**.

Bricks **9.2A*** Clay bricks shall be well burnt, hard, sound, square, clean, well burnt, even and uniform in shape and approved. Bricks with high sulphate content should be rejected. Bricks with an absorption of more than 20% by weight after immersion in water for 24 hours will not be accepted. Bricks for fair faced works to be "selected", being picked for evenness, texture, sharpness of arrises and uniformity of colour. Any "cracked" bricks should be rejected.

Brick size to be even in size to the tolerances laid down in **BS 3921** and comply with National Annex of **BS EN 771-1**, Table NA.1 with Work size to be 215 x 102.5 x 65 mm and Coordinating size to be 225 x 112.5 x 75 mm, or other dimensions subject to approval by the SO.

The content of heavy metals or their compounds in the product shall not exceed below levels:

(a) Cadmium: 1 mg/L

(b) Lead: 5 mg/L

(c) Arsenic: 5 mg/L

(d) Mercury: 0.2 mg/L

(e) Hexavalent Chromium: 5 mg/L

Bricks for fair-faced walling not plastered or rendered are to be especially selected from the stacks.

The crushing strength of bricks shall be as follows:

1) Load Bearing Walls - Not less than 20685 kN/m².

2) Non-Load Bearing Walls - Not less than 3447.5 kN/m².

Facing bricks **9.3** Facing bricks to have the following properties in accordance with **ASTM C216**:

(a) Compressive strength, the average compressive strength of 5 bricks must exceed 20.7 MPa; while the individual should not be less than 17.2 MPa;

(b) Saturation coefficient cannot exceed 0.78;

(c) Chippage, 85% to 100% of the brick can have chips that are measured from an edge that range between 0 to 7.9 mm and measured from a corner that range between 0 to 12.7 mm. No more than 15% of the brick can have chips that are measured from an edge that range between 7.9 to 11.1 mm and measured from a corner that range between 12.7 to 19.1 mm. The cumulative length of the chips around the perimeter edges of face cannot exceed 10% of the perimeter length;

(d) The faces shall be free of cracks or imperfections when viewed from a distance of 6 m.

Engineering bricks & loadbearing bricks **9.4** Engineering bricks and loadbearing bricks to be HD Type bricks to **BS EN 771-1** and comply with National Annex to **BS EN 771-1,** Table NA.6 (Class A: 125 N/mm^2 and Class B 75 N/mm^2, having absorption limits 4.5% and 7% respectively).

Fire bricks **9.5**

Fire bricks to be fire clay refractory bricks of specified class of the best quality, light in colour, uniform in texture and of standard sizes to **BS 3056-1**. Testing, if specified, shall be to **BS 1902-3.13** or **ISO 12678-2**.

Concrete bricks and blocks **9.6**

Concrete bricks and blocks to be to **BS EN 771-3** & **BS EN 772-2.** The mean compressive strength to be not less than 7.0 MPa. Concrete bricks to be of the same size as clay bricks.

Concrete blocks to be of the thickness specified and other dimensions as approved.

Concrete bricks or blocks for fair face work to be "selected", being picked for evenness, texture and sharpness of arrises.

The content of heavy metals or their compounds in the product shall refer Clause 9.2.

9.6A*

Dense concrete block walls shall generally be 100mm thick and provided for partitioning of areas where ceramic wall tile / paint finish is to be applied.

(a) All blockwork shall be tied to the structure and shall incorporate restraining posts and return walls for reasons of stability. Blockwork shall be suitably sealed at all junctions with the structure and where services penetrate walls to maintain the required fire integrity.

(b) Where conduits are embedded in the block walls, a strip of steel lathing extending 150mm in width on each side of the conduits shall be fixed with 40mm nails or stapled with plugs at 100mm centers on both edges.

(c) All block walls to be adopted in quarter units should be able to bear minimum 1kPa elevation loading capacity for future built-in furniture or hanging objects like hanging cabinet and wall mounted television set at living room, floor and hanging cabinet/ at kitchen and bathroom and built-in wardrobe for all bedrooms.

(d) Precast concrete building blocks, either of an accepted proprietary brand or cast by the Contractor, shall comply with the requirements of **BS 6073-1**

Concrete hollow block **9.7**

Same as in Clause 9.6, except that the mean compressive strength to be not less than 5.0 MPa of the gross area.

Glass blocks **9.8**

Hollow glass blocks to be hermetically sealed hollow units made of clear, colourless glass with a polyvinyl butyral edge coating, manufactured strictly in accordance with **BS EN 1051-1**, to a single compressive strength value of not less than 6 N/mm² and an average value of not less than 7 N/mm².

Damp proof courses **9.10A***

Damp proof courses to be 2 layers of 2-ply bituminous paper, or of other types, to **BS 6398, BS 6515, BS 8215 and BS 743 Type B** as weighing 3661.8 g/m2 placed over the full thickness of the walls and lapped 150mm at joints. Do not use hessian based types of bitumen damp proof courses.

Lay one layer of 3 ply bituminous Hessian felt across concrete and brick walls above ground to form a damp proof course where shown on the Drawings. All felt is to be protected by 6mm cement rendering during construction.

Wall ties **9.11A***

Ties for cavity walls to be formed 20 x 3.2 mm galvanised steel flats and to be vertical twist type to **BS EN 845-1+A1**, except that the overall length of the ties shall be minimum 100 mm longer than the width of the specified cavity.

Ties for use in cavity walls in which one or both leaves consists of sand-lime or concrete bricks or blocks shall be wire ties complying with the same BS.

The ties shall be spaced 900mm apart horizontally, 450mm vertically and staggered and with extra ties at reveals and openings; the tiles to be carefully laid so that they do not fall towards the inner thickness of the walls.

Ties between ends of walls and concrete to be one of the following:

(a) 6 mm diameter steel rods not less than 350 mm long, painted with 2 coats of bituminous paint, cast into the concrete at 300mm vertical centres and projecting 230mm from the concrete face.

(b) 20 x 3 mm galvanised steel flats 350 mm long, fanged at both ends.

Strips of approved brickwork reinforcement 350 mm long of the following widths:

(i) For 100-105 mm walls, 60 mm
(ii) For 200-225 mm walls, 110 mm

Where strips are to be fixed by shot firing, the length may be reduced subject to approval.

Ties for walls built against face of concrete to be formed from 20 x 3 mm galvanised steel flats 150 mm long, fanged at both ends.

Cement **9.12** Cement to be as Clause 6.27.

Water **9.13** Water to be as Clause 6.35.

Sand **9.14** Sand to be clean, hard, durable crushed rock or clean sand to conform to the grading limits set out in Table 9.1

TABLE 9.1
Grading

BS Sieve	% by weight passing BS sieves
5.00 mm	100
2.36 mm	90-100
1.18 mm	70-100
600 µm	40-100
300 µm	5-70
150 µm	0-15

Sand, other than the 5.00 mm size, whose grading falls outside the limits set out in Table 9.1 by a total amount not exceeding 5% may be accepted. The quantities of clay, fine silt and fine dust present when determined by the methods given in **BS EN 932-1, BS EN 932-6** and **BS EN 933-7** shall not exceed 10% by weight. Sand for fair faced works to be free from salt causing efflorescence.

Lime **9.15A*** Lime to be hydrated lime or quicklime to **BS EN 459-1**, delivered in sealed bags bearing the manufacturer's name or brand. The use of shell lime for mortar will not be permitted.

Lime putty **9.16A*** Prepare lime putty as **PD CEN/TR 15123, BS EN 13914-2** and **BS 8481** by adding hydrated lime to water, and mix to a thick, creamy consistency. Leave undisturbed for 16 hours (minimum) before use. Properties of lime putty shall be according to Table 9.1A*.

TABLE 9.1A*

Properties	Method of Test	Requirement
Adhesion to concrete	**JG/T 3049, EN 1015-12**	
	- Initial	> 0.7 N/mm2
	- Immerse in water	> 0.5 N/mm2
Compressive strength	**BS 6319-2, EN 1015-11**	> 5 N/mm2
Flexural strength	**BS 6319-3**	> 2 N/mm2

Shrinkage	**Coutinho Ring**	Nil
Mould resistance	**BS 5980**	No mould growth
Water resistance	**BS 3900:G5, JG/T 3049**	Resistance to water immersion
Water retentivity	**BS 4551**	> 99%
Alkaline resistance	**BS 3900:G5, JG/T 3049**	Resistance to alkaline immersion

Plasticiser **9.17** Plasticiser to be an approved proprietary brand to **BS EN 934-3**.

Proportion **9.22** Mix constituents to the following proportions:

(a) Cement mortar to be: cement and sand 1:3.

(b) Cement/lime mortar to be: cement, lime putty and sand 1:1:6 for external walls and 1:2:9 for internal walls.

(c) Firebrick mortar to be:

(i) An approved proprietary brand of fire cement, used neat, or

(ii) High alumina cement to **BS EN 14647** and fine crushed firebrick 1:2, tested to **BS 4551+A2** if required by the SO.

Proportions given are for dry sand. Allow for bulking.

Where plasticisers are used, they shall be used strictly in accordance with the manufacturer's recommendations and the proportions of the mortar mix adjusted accordingly.

Testing **9.24** The proportions of the materials used in Clause 9.22 with proper mixing shall have a mean compressive strength as Table 9.2.

TABLE 9.2
Strength of mortar

Type of mortar	Mean compressive strength at 28 days
(cement: lime: sand) 1: 0 to 0.25: 3 1: 1: 5 to 6 1: 2: 8 to 9	(site tests) 11 MPa 2.5 MPa 1.0 MPa

Testing on strength of mortar is normally not required. However, when specified, the testing to be in accordance with **PD 6697**, **BS EN 1996-1-2**, **BS EN 1996-2** and **BS EN 1996-3**.

Lintels **9.46** Construct concrete lintel for openings at brickwork and blockwork as per Clause 6.68. Alternative proprietary product may be accepted ~~subject to approval by the SO~~.

High density gypsum block wall **9.47*** Proprietary high density gypsum block wall system shall be composed of high density gypsum blocks, stiffening steel post and beam (as necessary), dowel bar, gypsum based adhesive, gypsum filler, fire resistant sealant and the gypsum block work accessories such as ties, anchors, isolation joints with adjacent structural elements, etc. The Contractor shall ensure that all components of the system are suitable for use for the specific purpose of each individual case and be compatible with one another and the finishing material.

Proprietary high-density gypsum block wall shall be to **BS EN 12859** to the tolerance within +/- 2.0mm, +/- 1.5mm and +/- 0.5mm respectively for length, height and thickness, with characteristics according to **Table 9.2A***.

TABLE 9.2A*

Properties	Requirement
Physical Characteristic	Tongue and groove profiles on all sides, smooth surface finish
Density	Not less than 1,000 kg/m3
Compressive Strength (**BS EN 13279-2**)	>10 MPa
Water Absorption (**BS EN 12859**)	<5% (H2)
Sound Insulation (**BS EN ISO 140-3**)	STC 40 or higher

The Sound Transmission Class (STC) rating of high density gypsum block wall system shall achieve a min. value of STC45 as tested in accordance with **ASTM E-90-4** "Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions."

The high density gypsum block wall system shall be capable of resisting the action of fire according to the required Fire Resistance Rating when tested in accordance with **BS EN 1364-1** or **BS 476-22** and designed to withstand a lateral loading of 1.5kPa.

(a) High density gypsum block

(i) The performance characteristics of high density gypsum block shall be in compliance with **EN 12859**. Supply of material shall be consistent in quality, colour, batch to batch and within same batch.

(ii) Solid construction with tongue or groove profile on four sides, smooth finished surface and ready to receive the surface finishes, fire rated to the specified rating and in nominal size of 500 x 500 x 100mm thick.

(iii) Density shall be min. 1,200kg/m^3 with a compressive strength not less than 14N/mm^2 tested under CSI:1990. Tolerance on dimensions and flatness of high density gypsum blocks shall comply with **EN 12859**. Water absorption shall be Class H1 when tested in accordance with **EN 12859**.

(b) Gypsum based adhesive shall be made and supplied by the same manufacturer as the high density gypsum block to ensure compatibility and overall performance of the system. It shall be applied as a bonding agent for all interlocking joints of the high density gypsum block wall. It shall also be used to make good the joints of the high density gypsum block in order to receive the finish. Mixing and application of the adhesive shall be in strict compliance with the manufacturer's instructions.

(c) The gypsum block wall shall be constructed and handled in accordance with the specification of the manufacturer. All abutments to the RC wall/ column/ ceiling shall be constructed in accordance with manufacturer's instructions with suitable fillers.

(d) The high density gypsum block wall system shall be able to withstand

(i) Line load of 2.0 kN/m to be applied at 1.1m above finished floor level.

(ii) Uniformly distributed load of 1.5 kPa on the infill between the floor level and the line at 1.1m above finished floor level.

(iii) Concentrated load of 1.5 kN to be applied on any part of the infill between the floor level and the line at 1.1m above finished floor level.

(e) 150mm high reinforced concrete curb shall be provided at the base of all Gypsum Block wall in wet areas and areas as specified.

Expansion and Contraction Joints in Brick or Block Walls **9.48*** When specified, brick and concrete block partition walls shall have expanded polystyrene foam or accepted flexible fire stop material, as required as separation strip between the top of the wall and the concrete soffit over.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 10

MASONRY

SECTION 10
MASONRY

GENERAL

Stone **10.1** Stone, generally, shall be granite of consistent colour, free from defects and ferrous materials that will adversely affect strength or appearance, to **BS EN 771-6** and shall comply with **BS EN 1996-1-1, NA to BS EN 1996-1-1, BS EN 1996-1-2, NA to BS EN 1996-1-2, BS EN 1996-2, NA to BS EN 1996-2, BS EN 1996-3, NA+A1 to BS EN 1996-3** and **PD 6697** when applied to masonry structures. Test methods according to clause 2 of **BS EN 771-6.**

10.1A* (a) Natural Stone

All natural stone finish referred to in this specification shall be of the high end of the market and from the same quarry. All granite materials are to be in accordance with this specification unless otherwise approved.

The natural stone panels shall be hard, durable, maintenance free. It shall be durable, with high resistance against scratches, impacts, acid and alkalis.

(i) Natural Stone Selection

(1) All natural stone shall be dense fine grained and shall be carefully selected to provide uniformity in colour, texture and finish.

(2) The natural stone shall be free of fractures, veins or clefts, which may affect the structural integrity of the stone.

(3) The natural stone shall be free from minerals that may cause deterioration, objectionable staining under normal environmental conditions.

(4) Stained or discoloured marble/granite considered to be due to weathering along joints or cracks shall not be acceptable. Panels displaying incipient iron staining shall also be unacceptable. Material containing relatively high concentrations of micro cracking or altered minerals which is considered to be due to surface alteration, and characteristic of material extracted from near the surface of the quarry, shall not be accepted.

(b) Quartz Stone

Quartz stone should achieve the following performance standards:

Specific gravity (**ASTM C97**)	: 2.382
Water Absorption (**ASTM C97**)	: 0.02~0.13%
Density (**ASTM C97**)	: 148.64 lb/ft^3 (2381 kg/m^3)
Dry Modulus of Rupture (**ASTM C99**)	: 3,534 psi (24.360 MPa)
Dry Compressive Strength (**ASTM C170**)	: 27,234 psi (187.75 MPa)
Dry Flexural Strength (**ASTM C880)**	: 7,158 psi (49.350 MPa)
Coefficient of Linear Thermal Expansion	: 11.99 x 106 in/in ºF

(**ASTM C531**)	: 21.58 x 10-6 cm/cm ºC
Acid Resistance (**ASTM C217**)	: Excellent
Hardness **(MOHS Hardness**)	: Scale 7
PEI Rating (**EN154, ISO TC/189**)	: V
Freeze-Thaw Cycling (**ASTM C67**)	: Unaffected
Flame Spread (**ASTM E84-97a**)	: Class A
Smoke Developed (**ASTM E84-97a**)	: Class A
Pencil Hardness (**KSD 6711-97**)	: 9H
Flexural Properties (**ASTM D 780**) (test speed: 6mm/min.) (Distance between the support: 250mm)	: 362,000kg.f/cm^2
Izoid Impact Strength (**ASTM D256a**)	: 1.6kg.fcm/cm
Barcol Hardness (**ASTM D 2583**)	: I 90
Rockwell Hardness (HRM) (**ASTM D 785a**)	: 121
Tensile Strength (**ASTM D 638**) (test speed:5mm/min)	: 133kg.f/cm^2
Flexural Strength (test speed: 6mm/min) (distance between support: 250mm)	: 327kg.f/cm^2
Deflection Temperature (**ASTM D 648**) (Flexural stress: 18.5kgf/cm2)	: 154 ºC

Micro conditions of exposure **10.2** Micro conditions of exposure of completed masonry, as in Clause 2.1.2.1 and Annex A of **BS EN 1996-2** shall be categorised into classes, as follows:

MX1 - In a dry environment;
MX2 - Exposed to moisture or wetting;
MX3 - Exposed to moisture or wetting plus freeze/thaw cycling;
MX4 - Exposed to saturated salt air or seawater;
MX5 - In an aggressive chemical environment.

Masonry units, mortar, concrete infill, ancillary components and reinforcement shall be selected according to Annex B and C of **BS EN 1996-2** based on the appropriate class of micro conditions of exposure of completed masonry.

PRODUCTS

Mortar **10.4** Mortar shall be as Clauses 9.12 to 9.17 and 9.21 to 9.25.

Damp proof course **10.5** Damp proof course shall be as Clause 9.10.

Wall ties **10.6** Ties between walls and concrete shall be 20x3 mm stainless steel 316 flats 350 mm long, fanged at both ends and shall be to **BS EN 845-1+A1**.

"Ties for walls built against face of concrete to be formed from 20 x 3 mm stainless steel 316 flats 150 mm long, fanged at both ends and shall be to **BS EN 845-1+A1**."

Reconstituted Stone Panels **10.25***

(a) The reconstituted stones shall be hard, durable, maintenance free and non-water absorbing with high resistance against scratches, impacts, acidic and alkaline attacks.

Design and installation of stone panels shall comply with BS8298 and shall have minimum wall thickness of (a) 20mm for internal stone wall panels and 32mm for internal paving stones, and (b) 32mm for all external stones.

Structural calculations from stone supplier are required to support structural adequacy of the proposed thickness.

(b) The Contractor shall prove and demonstrate that the manufacturer possesses the production technology for production of high-quality compound stone artificial tiles and that the artificial compound stone tiles can be cut into various sizes, shapes, textures and finishes to meet the design requirements. Quality control and standardized tests shall be conducted in authorized or certified laboratories.

(c) A minimum of 10 colors (including non-standard colors) and full range of patterns shall be available for selection. All colours and patterns shall be applicable for general, border and pattern to meet the design requirements.

(d) Batch-to-batch colour shall be matched to ensure consistency.

(e) The reconstituted stone panels shall achieve the following performance standards. Other equivalent international standards are also acceptable.

Density (**BSEN 14617-1**)	:	2350-2500kg/m^3
Water absorption (**BSEN 14617-1**)	:	<0.1%
Surface scratch hardness (**EN 101**)	:	6-7 Mohs
Flexural strength (**BSEN 14617-2**)	:	>35N/mm2
Abrasion resistance (**BSEN 14617-4**)	:	139-275mm3
Compressive strength (**BSEN 14617-15**)	:	>110MPa
Chemical resistance (**BSEN 14617-10**)	:	Class C4
Linear thermal expansion (**BSEN 14617-11**)	:	23-26x10-6/°C

Stone Protection Agent **10.26***

(a) All natural stone surfaces (both exposed and concealed surfaces) shall be coated with 4 coats of proprietary transparent sealer to ensure that the granite floor slabs are protected from staining by water, grease, oil and other staining substances.

(b) The external granite panels shall be applied with two coatings of the osmotic stone protection agent or other products having equivalent functions or performance.

(c) The granite paving/floor panels with unpolished or flamed finish shall be applied with two coatings of clear polyurethane finish or other approved equivalent as a sealer for the granite surface.

(d) The granite paving/floor panels of the polished or honed finish shall be applied with two coatings of penetrating impregnator/sealer for protection of the granite surface and for achieving a slip resistant surface.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 11

TANKING

SECTION 11
TANKING

Design **11.1** The design of tanking shall comply with **BS 8102** - protection of structures against water from the ground.

11.1A* Basement external tanking system for below-grade applications shall achieve **Grade 2** protection in accordance with **BS 8102**~~.~~ The barrier or membrane shall also be resistant to the attack of chemical and ground contaminants.

Combined waterproofing protection for below-grade structure shall achieve **Grade 3** performance level in accordance with **BS 8102** (except Grade 2 for plant rooms areas).

Mastic asphalt **11.3** Mastic asphalt for tanking shall comply with type T1097 to **BS 6925** (lime stone aggregate). All mastic asphalt blocks delivered to site must bear legible markings of:

(a) the name or trade mark of the manufacturer;

(b) the number and date of British Standard; and

(c) the type of number, e.g. T1097 to **BS 6925**.

Proprietary flexible sheet membrane **11.4** Proprietary flexible sheet membrane shall be capable of accommodating unanticipated cracks of up to 0.6 mm wide without losing its waterproofing properties, and the properties of the membrane in lap shear and lap peel shall not be less than 110 kN/m^2 and 3.3 kN/m respectively at site condition, unless otherwise approved by the SO. ~~Certificates together with complete test reports to substantiate that the materials supplied meet the requirements specified shall be submitted when the material is delivered to the Site.~~

Liquid applied membrane **11.4A** Liquid applied, elastomeric waterproofing shall be made of a pitch modified polyurethane, and shall be submitted for approval by the SO. The membrane shall be capable of an elongation of not less than 400% to accommodate cracks up to 2 mm without losing its waterproofing properties, and its tensile strength shall exceed 1.6 N/mm^2, and the tear resistance and adhesion strength shall not be less than 12 N/mm and 2.6 N/mm respectively at site condition, unless otherwise approved by the SO. It shall be applied in strict accordance with the manufacturer's instructions.

Cementitious waterproofing **11.4B** Cementitious waterproofing shall be compatible with host concrete and all surfaces and materials, including ancillary materials, in contact with the waterproofing system. The material shall be non-toxic. It shall suit the situation on which it is to be used.

11.4B(1)* Liquid applied cementitious waterproofing coating shall be of minimum 1mm thick, with minimum performance as follows:

Properties	Requirement
Material Base	Polymer modified cementitious
Component	Two-part (liquid + powder)
Density (mixed)	1.90 g/ml
Crack bridging (**ASTM C836-06**)	Passed 3.2mm
Pull off strength (to concrete) (**BS EN 1348**)	1.04 MPa
Pull off strength (compatibility of cement sand render on the	1.2 MPa

waterproofing membrane on concrete) (**BS EN 1348**)	
Adhesion strength (**HKHA Specification Library Method WAT 6.M010.A Clause 2(i)**)	0.693 MPa
Compatibility with tile adhesive (14 days under normal curing condition) (**BS 5980 Appendix D**)	3355N (average)
Compatibility with tile adhesive (7 days under normal curing condition and followed by water immersion for 7 days) (**BS 5980 Appendix D**)	3486N (average)
Elongation (**ASTM D412**)	667% (average)
Tensile Strength (**ASTM D412**)	1.57 MPa (average)
Non-toxic (**JC1066**)	Pass
Non-toxic (full System, with waterproofing, tile adhesive and tile grout) (**BS 6920**)	Pass
Efflorescence (full system)	No efflorescence with tile adhesive after 21 cycles
VOC	None
Temperature for application	+5 ºC or above
Water Pressure Test (72 hours) (**DIN1048-5**)	No sign of water penetration (5 bars, 50m height and 72 hours)
Water Pressure Test (Positive) (**DIN1048**) Water Pressure Test (Negative) (**DIN1048**)	No sign of water penetration (8 bars and 80m height) No sign of water penetration (3.5 bars and 35m height)

Spray polymer modified asphalt waterproofing system **11.4C***

Spray Polymer Modified Asphalt (PMA) waterproofing system shall be a field installed external tanking, waterproofing and gas vapor barrier system combrised of a water-based PMA waterproofing membrane in minimum 2mm thick with one or two High Density Polytheylene (HDPE) and Polypropylene fabric laminate sheet which provides the durability and chemical resistance with the constructability and installation efficiencies.

(a) PMA system for horizontal surface

(i) HDPE laminated polypropylene fabric side down base sheet / HDPE geomembrane

(ii) Water-based PMA spray applied membrane (min. 2mm thick)

(iii) HDPE laminated polypropylene fabric side up top sheet

(b) PMA system for vertical surface

(i) HDPE laminated polypropylene fabric side down base sheet / HDPE geomembrane

(ii) Water-based polymer modified asphalt spray applied membrane (min. 2mm thick)

Physical Properties for the waterproofing system shall be as follows:

Properties	Test method	Requirement
Specific Gravity	**ASTM D244**	1
Viscosity	**ASTM D1200**	> 25 centipoise
pH	/	12.3
Tensile Strength of system	**ASTM D412**	47.91 N/mm^2
Elongation	**ASTM D412**	4140%

Resistance to Decay	**ASTM E154 Section 13**	4% Loss in Performance and Passed (City of Los Angeles)
Moisture Vapour Transmission of system	**ASTM E96**	0.006979 g / hr / m^2 ≤1.83 x 10-12 g / Pa.s.m
Hydrostatic Water Pressure of system	**ASTM D5385**	>160 psi (112 m)
Adhesion to Concrete of system	**ASTM C836**	27 lbf. / inch (4.72 N/mm)
Adhesion of PMA spray waterproofing membrane to base film side	**ASTM C836**	28.35 lbf / inch (4.96 N/mm)
Hardness	**ASTM C836**	80
Crack Bridging	**ASTM C836**	No Cracking or separation of the membrane from the substrate
Low Temp. Flexibility	**ASTM C836**	No Cracking @- 20°C
Pull off Adhesion to Concrete	**ASTM D7234**	3.78N / mm^2
Chemical Resistance of system (i) Chlorinated Solvents (a) Perchloroethylene Weight Tensile Strength (b) Tricholorethylene Weight Tensile Strength (ii) Aromatic Hydrocarbon (a) Benzene Weight Tensile Strength (iii) Gases (a) Hydrogen Sulfide Weight Tensile Strength	**ASTM D543 ASTM D882**	Passed weight change 4.1% 6.5% 5.4% 6.0% 4.1% 4.4% 0.6% 0.8%

Properties	Test method	Requirement
Chemical Permeation over 500 hrs of system (i) Chlorinated Solvent (a) Perchloroethylene (b) Trichloroethylene (ii) Aromatic (iii) Hydrocarbon (iv) Benzene	**ASTM F739**	Perm Rate Ug/cm² (ml/day) 69.4 (0.0008) 89.8 (0.0012) 59.3 0.0 0.13
Coefficient of Friction-with geotextile both sides of system	**ASTM D5321**	a. For sand > 0.85 (kinetic) b. For clay > 0.64 (static) > 0.63 (kinetic)
Flammability	**ASTM D3143**	500°F (260°C)

Color	/	Brown to Black
Potable Water Containment	**ANSI / NSF 61**	NSF Certified for Tanks > 300,000 gal (1,135,623 litre)
Puncture Resistance of system	**ASTM E154**	Peak Load > 1318 N Extension > 60mm
Resistance to Decay	**ASTM E154 Section 13**	Passed (City of Los Angeles)
Accelerated Aging	**ASTM G23**	No Effect
Perm Rating of system (US Perms)	**ASTM E96**	≤0.021 Perm and ≤0.0013 Perm inch
Methane Transmission Rate of PMA spray waterproofing membrane to base film side	**ASTM D1434**	3.7 x 10-15
Soil Burial of system (i) Weight change (ii) Tensile Strength (iii) Elongation	**ASTM D4068**	Passed (City of Los Angeles) 1.2% 9.89% 2.2%
Oil Resistance of system (i) Weight change (ii) Tensile Strength (iii) Elongation	**ASTM D543** **ASTM D412**	Passed (City of Los Angeles) 7.6% 1.1% 4.4%
Heat Aging of system (i) Weight change (ii) Elongation	**ASTM 4068**	Passed (City of Los Angeles) 8.6% 8.9%
Environmental Stress (Cracking of system)	**ASTM D1693**	620 hrs; Passed (City of Los Angeles)
Specific Gravity	**ASTM D244**	1
Viscosity	**ASTM D1200**	> 25 centipoise
pH	/	12.3
Tensile Strength of system	**ASTM D412**	4.57 N/mm^2
Elongation	**ASTM D412**	4140%
Moisture Vapour Transmission of system	**ASTM E96**	0.006979 g / hr / m^2 ≤1.83 x 10-12 g / Pa.s.m

Waterproofing Concrete **11.14*** Waterproofing concrete shall be provided in accordance with **BS 8007** and **BS EN 934**. Waterproofed concrete to be mixed with waterproofing admixture, min. 1.75% by mass of cement and rubber water stop along all construction joints.

Waterproofing admixture shall be liquid applied capillary active waterproofing admixture, functions chemically and plasticizes the concrete, with nano-scale crystals are formed in the capillary system by special active catalysts, which become active on contact with water. The admixture shall be provided with crack healing properties for penetrating cracks up to 0.4 mm and for map and pattern cracks up to 0.5 mm. Physical properties for liquid applied capillary active waterproofing admixture shall be as follows:

Properties	Test Methods	Requirements
Form	-	Liquid (powder form is not allowed)
CE Marking	**EN934-2**	Classified as plasticizer for

		concrete
Propagation of microorganisms on materials for drinking water	**DVGW W270**	Meet
Hygienic requirements on materials for drinking water	**DVGW W347**	Fulfill
Water reducing	**-**	Up to 10%
Sulphate content (as SO3)	**QCC/LP6-07**	Less than 0.1 % (by mass of sample)
Normatively required migration coefficients (exposure class)	**DIN EN 206-1** **DIN 1045-2**	XS1, XD1 XS2, XD2

The efficiency of such waterproofing admixture for concrete in comparison to a reference concrete shall be as follows:

Properties	Test Methods	Requirements		
		Days	Reference concrete	Concrete with waterproofing admixture
Compressive strength and bulk density	**DIN EN 12390-3**	Bulk density (kg/m^3)		
		1 day	2300	2320
		7 days	2330	2330
		28 days	2320	2320
		Compressive strength (150mm cube) (MPa)		
		1 day	16.4	20.4
		7 days	48.5	47.5
		28 days	57.9	58.8
Penetration	**DIN EN 12390-8**	Depth of penetration of water under (mm)		
		730 days	22 (average)	10mm (average)
Chloride migration resistance	**BAW Merk-blatt**	Chloride migration coefficient Meanvalue DCL x 10-12 [m2/s]		
		56 days	14.7	8.9
Water Permeability Test	**BTD/TP /02/2002**	Average coefficient of Permeability, K (m/sec)		
		/	2.06 x 10^{-12}	4.78 x 10^{-13}

Properties	Test Methods	Requirements			
		Cycles	Reference concrete	Concrete with water-proofing admixture	Concrete with water-proofing admixture and air entraining agent
Freeze thaw salt resistance (28 days)	**BAW Merk-blatt**	Surface scaling in g/m^2			
		0	0	0	0
		4	36	51	59
		10	167	180	177
		14	386	345	282
		18	1053	611	376
		28	3680	1671	613
		Rel. Dynamic E-modulus in %			
		0	100	100	100
		4	99	99	100
		10	94	98	99
		14	91	97	98
		18	85	95	98
		28	70	95	97

High Puncture Resistant Floor Vapor Barrier **11.15*** High puncture resistant floor vapor barrier shall be pre-moulded membrane vapour seal of sheet applied vaporproofing membrane with plasmatic core in 3.18mm thick and a layer of geotextile to prevent cement sand to block the drainage aggregate

shall be in min. 200g/m^2. Physical properties for high puncture resistant floor vapor barrier shall be as follows:

Properties	Test Methods	Requirements
Permeance	**ASTM F1249 (**calibrated to **ASTM E96**)	<= 0.0011 Perms
Water vapor permeability	**ASTM F1249 (**calibrated to **ASTM E96,** water method)	<= 0.00715 g/m2 (24hours)
Tensile strength	**ASTM E154** (Section 9)	156 lbs. force/inch (27.38 N / mm)
Puncture resistance	**ASTM E154**	149 lbs. force/inch (26.15 N/mm)
Resistance to hydrostatic head	**ASTM D5385**	240 ft. (73.15m)
Exposure to Fungi (Soil Test)	/	Pass, 16 weeks
/	**ASTM E1993**	Achieved
Thickness	/	3.18mm (1/8")
Plasmatic core	/	Provided

Comprised of seven-ply, weather-coated, permanently bonded, bituminous core board. This core is sealed under heat and pressure between liners of asphalt-impregnated felt and a glass mat liner. An asphalt weather coat is applied to the glass-mat liner and covered with a polyethylene anti-stick sheet.

Liquid applied vapor inhibiting coating **11.16***

(a) Liquid applied vapor inhibiting coating shall be 2-component, moisture tolerant, extremely high-density epoxy based product fully broadcasted with silica sand in min. 1mm thick.

The coating shall be able to prevent the passage of water vapour and moisture through slabs on or below grade, thus eliminating delamination of adhesives, floor coverings and coatings. It also prevents capillary infiltration of oil or other chemicals from the ground and can be used to treat oil-contaminated slabs, with the following properties

(i) reduce water vapour emission levels of up to 25 lbs/1000 ft^2·24 hrs (5 g/m^2·hrs) to well below accepted levels for subsequent application of flooring systems such as epoxies, vinyl tiles, sheet vinyl, carpets, wood flooring, etc.

(ii) Resistant to chemicals rising from the soil with an excellent bonding on wet concrete surfaces. It is used as a primer for oil contaminated but cleaned concrete surfaces and for the priming of still damp concrete or screed surfaces which will be coated with epoxy flooring systems.

(b) The manufacturer for liquid applied vapor inhibiting coating must have a minimum of 20 years of experience in related business, meeting management standards of **ISO 9001** and **ISO 14001**.

(c) Physical properties shall be as follows:

Properties	Requirements
Basis	two component epoxy resin
Colour	light grey
Viscosity (4mm DIN standard cup)	70s
Density	1.86 g/cm^3
Mixture ratio	100:12 parts by weight
Pot life	Approx. 90 minutes at +10°C

	Approx. 60 minutes at +23°C Approx. 30 minutes at +30°C
Minimum cure temperature	+8°C (slow cure)
Foot traffic (at 23°C)	Approx. 12 hrs.
Consumption	min. 600 g/m²
Compressive strength	80 N/mm²
Flexural strength	30 N/mm²
Tensile adhesive strength (**EN 1542**)	≥ 2.7 N/mm2
Adhesion (to fresh concrete, 5 days)	110 psi (0.8 Mpa)
Adhesion (to moist / saturated concrete, 28 days)	550 psi (3.8 Mpa)
Adhesion (to dry concrete, 28 days)	580 psi (4.0 Mpa)
Recoat time (at 23°C)	12 - 24 hrs
Full strength (at 23°C)	7 days
Radon Barrier (diffusion coefficient)	< NWG m²/s (0.6mm thick)
Abrasion resistance (**ASTM D4060**)	≤ 209 mg
Capillary Water Absorption and Water Permeability (**EN 1062-3**)	W ≤ 0.001 kg / m2 x h 0.5
Reaction to fire (**DIN EN 1504-2**)	Class E
Penetration depth (**DIN EN1504-2**)	Klasse I <10mm
Water Vapor Permeability (**DIN EN 1504-2**)	Class III
Moisture vapor transmission (**DIN 53122)** T1 free film, under 677µm thickness)	≤ 0.08 g/m²/24hrs
Water vapor diffusion (**DIN 53122)** T1 free film, under 677µm thickness)	µ ≥ 738,000
Sd [H2O] (**DIN 53122)** T1 free film, under 677µm thickness)	≥ 500m

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 12

ROOFING

SECTION 12
ROOFING

COVERINGS AND FLASHING

Lead **12.1** Sheet lead shall be to **BS EN 12588**, 1.8 mm thick, Colour Code Blue.

Copper **12.2** Sheet copper shall be to **BS EN 1172,** CW024A.

Aluminium **12.3** Sheet aluminium shall be to **BS EN 485-1, BS EN 515, BS EN 573-3,** AW-1199.

BITUMEN FELT BUILT-UP ROOFING

Bitumen felt **12.8** Bitumen felt shall be in accordance with **BS EN 13707**, and shall be as follows:

Underlayer to consist of one or more layers, as specified, of approved fine granule surface felt (nominal weight 1.8 or 2.5 kg/m^2).

Top layer shall be one of the following:

(a) Approved mineral surfaced felt, (nominal weight 2.8 kg/m^2).

(b) Approved fine granules surfaced felt (nominal weight 2.5 kg/m^2) with surface dressing.

Rolls shall be delivered to Site bearing the trade mark and certification as to BS type.

Bitumen primer **12.9** Bitumen primer shall be selected to suit the type of bonding compound.

Bonding compound **12.10** Bonding compound shall be bitumen based.

Dressing compound **12.11** Bitumen dressing compound shall be cut-back bitumen to **BS EN 12591, BS EN 13924-1** and **BS EN 15322** class 1.

Stone chippings **12.12** Stone chippings shall be light coloured, hard and free from brown or partially decomposed stone. Chippings shall be graded from 5 mm to 3 mm.

Nails **12.13** Nails for fixing felt to timber decks shall be galvanized steel or non-ferrous metal with 3 mm diameter shank and 11 mm diameter clout head and 20 mm long.

BITUMINOUS EMULSION ROOFING

Bituminous emulsion **12.25** Bituminous emulsion for roofing shall be an approved compound. Use in accordance with the manufacturer's recommendations.

Glass fibre membrane **12.26** Glass fibre membrane shall be a woven material with a thread count of 8 x 8 mm per 10 mm^2 (minimum).

CHINESE TILE ROOFING

Tiles **12.36** Tiles shall be sound, well-burnt unglazed clay, whole, and free from cracks and blemishes. Approximate sizes shall be:

Plain tiles 225 mm x 225 mm
Roll tiles 165 mm long, and tapered
Valley tiles 300 mm x 225 mm

Mortar **12.38** Mortar shall be cement/lime mortar, as Clauses 9.15 to 9.25.

Nails **12.39** Nails shall be aluminium or galvanized steel nails at least 2 mm diameter 30 mm long and with plain heads.

Special tiles **12.40** Roll tiles to be left exposed shall be specially selected and semi-circular in section. Glazed tiles shall be obtained from an approved manufacturer.

MASTIC ASPHALT ROOFING

Mastic asphalt **12.52** Mastic asphalt shall be as follows:

(a) Mastic asphalt (limestone aggregate) to **BS 6925**, type R988 manufactured with asphaltic cement specified under Table 1 column B (100% Bitumen).

(b) Mastic asphalt (limestone aggregate) to **BS 6925**, type R988 manufactured with asphaltic cement specified under Table 1 column T25 75% Bitumen and 25% Lake Asphalt.

Testing **12.53** Sampling and testing shall be carried out in accordance with **BS 5284**. Deliver samples to the Public Works Laboratories (PWL) as directed by the SO. Results shall be in accordance with **BS 6925**.

Isolating membrane **12.54** Black sheathing felt shall be to **BS EN 13707**.

Dressing compound **12.55** Bitumen dressing compound shall be cut back bitumen to **BS EN 12591, BS EN 13924-1** & **BS EN 15322** Class 1.

Sand finishing **12.56** Sand finishing shall be fine, clean and the particles of which must pass a 600 μm mesh BS sieve and be retained on a 300 μm mesh BS sieve.

Chipping finish **12.57** Granite chippings shall be best quality grey granite free from brown and partially decomposed stone graded to pass a 5.00 mm mesh BS sieve and be retained on a 2.36 mm mesh BS sieve.

Reflective paint **12.58** Reflective paint shall be an approved bituminous based aluminium paint or an approved paint compatible with bituminous surfaces.

Reinforcement **12.59** Reinforcement shall be bitumen coated "plain expanded" metal lathing to **BS EN 13658-1 & BS EN 13658-2**.

Expansion joints **12.69** ~~Expansion joints shall be constructed strictly as indicated on the drawings.~~

Pointing shall be in accordance with the specification for "Movement Joints" in Clauses 6.61~~ and 6.62.~~

Flashings and coverings shall be in accordance with the specification for leadwork in Clauses 12.1~~ and 12.4.~~

STEEL SHEET ROOFING AND CLADDING

Corrugated sheets **12.72** Steel corrugated sheets shall be hot-dipped galvanized corrugated sheets to **BS 3083** and to be at least 0.6 mm thick, with corrugations 76 mm wide and 19 mm deep.

Profiled sheets **12.73** Profiled steel sheets to **BS 5427-1+A1** shall be obtained from approved manufacturer of profile, thickness, finish and colour as specified.

Accessories **12.74** Accessories for steel sheets shall be made from 0.6 mm (minimum) thick galvanized steel sheet or to be approved proprietary fittings. Accessories for colour coated sheets shall be obtained from the approved manufacturer of the sheets.

Fixings **12.75** Hook bolts and nuts, drive screws, washers, self-tapping screws, roofing bolts, nuts and clips, roofing screws and sheeting clips shall be galvanized steel to **BS 1494**: Pt. 1 or electro-plated to **BS 7371-3** and of the sizes and finishes specified.

~~Alternatively, recommended specialist fixings from an approved manufacturer of the roofing sheets.~~

Bolts and screws shall be fitted with large washers compatible with sheets and shall be capable of withstanding up-lift under typhoon conditions.

Where coloured roofing sheets are used, fixing heads shall be covered with plastic caps to match the colour of the sheets.

Rivet fixings may only be used with the permission of the SO, and then only for vertical flashings.

ALUMINIUM SHEET ROOFING AND CLADDING

Profiled aluminium sheets **12.84** Aluminium corrugated and profiled sheets shall be to **BS 4868**. Corrugated sheets shall be at least 0.6 mm thick with corrugations 76 mm wide and 19 mm deep. Profile sheets shall be of the profile, thickness, finish and colour as specified.

Accessories for profiled aluminium sheets **12.85** Accessories for profiled aluminium sheets shall be made from aluminium flat sheet at least 0.6 mm thick and of similar finish and colour to the profiled sheets or to approved proprietary fittings. Accessories for colour coated sheets shall be obtained from the approved manufacturer of the sheets.

Fixings **12.86** Fixings for aluminium profiled sheets as Clause 12.75.

PROFILED GLASS-FIBRE REINFORCED PLASTIC (GRP) SHEETS

Profiled glass-fibre reinforced plastic sheets **12.89** Profiled glass-fibre reinforced plastic (GRP) sheets shall be to **BS 4154-1** & **BS 4154-2**. The resin system, as regards physical properties, shall be to **BS 3532**. The profile, thickness, translucency and colour shall be as specified.

Where fire protection requirements apply, the GRP sheets shall be tested in accordance with **BS 476-3** and **BS 476-7** and the fire performances achieved by the samples shall be stated.

The sheets shall be marked with the name or trademark of the manufacturer, the BS number 4154 and the designation of the test samples of the translucent sheet in accordance with **BS 476-3**, where so claimed by the manufacturer.

Fixings **12.90** Fixings for glass-fibre reinforced plastic sheets as Clause 12.75.

PROFILED UNREINFORCED RIGID PVC SHEETS

Profiled unreinforced rigid PVC sheets **12.92** Profiled unreinforced rigid PVC sheets shall be **BS 4203-1 & BS 4203-2**. The profile, thickness, colour and transparency shall be as specified. The sheets shall be marked with the name or trademark of the manufacturer, the date of manufacture and the number of the BS and the type.

Fixings **12.93** Fixings for PVC sheets as Clause 12.75.

PROFILED COMPRESSED PARTICLE SHEETS

Profiled compressed particle sheets and accessories **12.96** Profiled compressed particle sheets and accessories shall be as specified and not to contain asbestos materials of any kind.

Fixings **12.97** Fixings for compressed particle sheets as Clause 12.75.

PROPRIETARY ROOFING SYSTEMS

Roofing system **12.100** All waterproof Roofing Covering Materials shall be materials of the proprietary roofing system and which are subdivided into four groups as follows:

(a) Type 'AI' Roofing Sheet Materials requiring Protection.

(b) Type 'AII' Roofing Sheet Materials with self finishes not requiring any protection finishing on top.

~~(c) Type 'BI' Liquid Applied Roofing Materials requiring Protection.~~

(d) Type 'BII' Liquid Applied Roofing Materials with self finishes not requiring any protection finishing on top.

12.100A* (e) Type 'BI' Liquid Applied Roofing Materials or equivalent shall be minimum 1.5mm thick requiring Protection.

ROOF FINISHES

Insulation **12.120*** Insulation shall be min. 50mm thick proprietary rigid extruded polystyrene foam board with extremely low water absorption, high compressive strength to withstand the design load, CFC free and high long-term thermal insulation efficiency.

Polystyrene roof insulation shall be self-extinguishing extruded type with a density of 32 kg/m3 and a compressive yield of 3.5 kg/cm2 with a minimum deformation of 3%.

Polystyrene roof insulation where vehicular traffic is accessible shall be self-extinguishing extruded type with a minimum density of 45 kg/m3 and a compressive yield of 7.0 kg/m2.

Expansion Joints **12.121*** For external areas accessible by the public, proprietary product of stainless steel with integrated matching finishes cover shall be adopted. Alternatively, proprietary products with details allowing minimal joint width while maintaining good waterproofing protection could also be considered.

FAST CURED SPRAY APPLIED WATERPROOFING MEMBRANE

General **12.122*** The waterproofing shall be supplied by an accepted supplier operating an ISO 9000 quality assurance scheme.

Waterproofing Roofing System **12.123*** (a) Spray applied fast cure high strength polyurethane

The waterproofing roofing system shall be spray applied fast cure high strength polyurethane (not polyurea or polyurea hybrid) waterproofing membrane system in min. 1.5mm thick.

Minimum Performance:

The waterproof membrane shall be a fast cure spray applied two-component solvent free elastic Polyurethane based (not Polyurea or Polyurea hybrid) waterproofing coating and contains no fillers in any part of the materials. The cured liquid polyurethane membrane shall not be less than 1.5mm thick, applied in a sprayed single coat and capable of accepting light foot traffic after three minutes.

The waterproofing system shall be a multi-layered system comprising a sealer/primer applied on substrates (including but not limited to dry concrete, damp concrete, metal or other substrate) and waterproofing membrane that prevents the

passage of water. The sealer / primer shall be supplied by the same waterproofing manufacturer.

The cured, waterproof membrane shall be root and chemically resistant, particularly to the effects of water, sea and waste water, as well as a variety of alkalis, diluted acids, mineral oils, lubricants and fuels. Physical Properties shall be according to Table 12.1A*.

TABLE 12.1A*

Properties	Requirement	Method of Test
Description and base	Solvent free two component spray applied Polyurethane waterproofing membrane	---
Ready for foot traffic	Max. 180 seconds	---
Solid Content	100%	---
CE-Marking	ZA.1d, ZA. 1e, ZA.1f and ZA. 1g	**EN1504-2**
Roofing Materials	Type BII Liquid Applied Roofing Materials with Self Finishes	---
Withstand temperature during laying of hot poured asphalt	240°C (approx.)	---
Cadmium (Cd), Lead (Pb), Chromium (Cr) & Mercury (Hg)	Not Detected	**EPA 3052 & EPA 6010B**
Adhesion to concrete	> 4.0 N/mm²	**ASTM D4541**
Adhesion strength after 1000 hrs (41.7 days) QUV exposure	> 2.60 N / mm²	**ASTM D4541 & ASTM G154**
Adhesion to steel	> 10 MPa	---
Resistance to aggregate	No change	---
Chisel impact test	No change	---
Resistant to Ballast Penetration	Can withstand the stresses imposed during the pulsating load test with test loads equivalent to an axle load of 280 kN, over 2.7 x 106 cycles and without perforation	---
Impact Resistance	> 200 N/mm	**ASTM G14**
Hardness	80 (Shore A)	---
Properties	Requirement	Method of Test
Median Tensile strength	9.4 – 11.9 N/mm² average (1.5 - 2mm thick, 1,3 & 7days); shall not be over 16N / mm2	**ASTM D412**
Tensile strength (a) Heat treatment (b) Exposure treatment (c) Alkali treatment (d) Acid treatment	 (a) 102 kg f / cm² (Passed) (b) 92 kg f / cm² (Passed) (c) 93 kg f / cm² (Passed) (d) 97 kg f / cm² (Passed)	**JIS A 6021**
Median Elongation	530 - 580% average (1.5 - 2mm thick, 1, 3 & 7days)	**ASTM D412**
Elongation at break (a) Heat treatment (b) Exposure treatment (c) Alkali treatment (d) Acid treatment	 (a) 700% (Passed) (b) 498% (Passed) (c) 677% (Passed) (d) 625% (Passed)	**JIS A 6021**

Tear strength	40 - 47 N/mm	**DIN 53363**
Water vapour transmission rate (2.1mm film)	> 5.6 g/m²·24	**ASTM E96 (Method B)**
Water vapor transmission rate (1.5mm film)	19 g/m²·24 hrs	**BS 3177**
Water vapour permeability	800 ym	**DIN 52615**
Water absorption	7.6 x 10-3 kg / m²	**DIN EN 14224**
Crack Bridging ability at 22°C	> 6mm (22°C)	**Munchen Technical University**
Dynamic crack bridging at 20°C	1000 cycles 0.25mm – 0.75mm (-20°C) Passed	**DIN EN 14224**
Heat aging at 70°C	28 days, no change	**ZTV-SIB 90**
Abrasion Resistance	< 22.6 mg (CS-17, 500 cycles)	**ASTM D4060**
Watertightness	Resistant to 10 bar (100m water head) negative water pressure	**---**
Root penetration resistance	No penetration of roots	**DIN 4062**
Potable Water Safety	Passed	**BS 6920-1 clause 8**
	Passed	**WRc – NSF**
Reaction to Fire	Ext 'F.AA' on cement board Ext 'F.AC' on concrete	**BS 476-3**
	No flaming droplets and fire 4ehaviour classified as 'E'	**EN ISO 11925-2**
Electric resistance (Surface resistance) (MΩ)	4.2 x 106	**ASTM D257**
Electric resistance (Volume resistance) (MΩ・cm)	2.1 x 105	**ASTM D257**
Chemical resistance (23°C, 7 days) (a) Engine oil (b) Gasoline (c) Diesel (d) 10% CaCl2 (e) 10% NaCl	No change on surface	**ASTM D543**

Properties	Requirement	Method of Test
Chemical Resistance, after 7-day immersion - 10% HCI (hydrochloric acid) - 10% CH3COOH (acetic acid) - 20% Na2CO3 (sodium carbonate) - 10% NaCl (sodium chloride) - 10% NaOH (sodium hydroxide) - Sea water - Diesel - 10% H2SO4 (sulphuric acid)	No disintegration, blistering, swelling, peeling or cracking (7 days full immersion)	**ASTM C868**

- 10% HNO3 (nitric acid) - 10% H3PO4 (phosphoric acid) - Hydraulic oil - Brake fluid		
Chemical resistance to: Acetic acid 10% Ammonia 5% Boric acid 2% Caustic potash solution 5% Citric acid 4% Disinfectants 10% Distilled water 10% Ethanol 10% Formaldehyde 10% Formic acid 5% Glycerine 2% Hydrochloric acid 10% Hydrogen peroxide 10% Kerosene 25% Lactic acid 25% Phosphoric acid 10% Potassium 10% hydroxide 50% Salt solution 40% Soda lye 5% Soda solution 20% Sodium carbonate 20% Sodium chloride 10% Sodium hydroxide 50% Sugar solution 40% Sulphuric acid 25% Tannic and solution 30% Tap water 25%	Resistant	---

Properties	Requirement	Method of Test
Expected service life after accelerated weathering tests	At least 25 years	**BBA**
Volatile Organic Compound (VOC)	0.01g/ltr	**Headspace GC-MSD**
Total Halogenated Organic Solvet	Not Detected	
Total Aromatic Organic Solvent	0.0003 g / ltr	
Epichlorohydrin	Not Detected	
Green Label	Yes	**Singapore Green Labelling Scheme (SGLS)**
Formaldehyde	Not Detected	**High Performance Liquid Chromatography**

Ozone resistance	Passed	---
Water pressure resistant	10 bar under 3.5 hours	**CNS 10145**

(b) Adhesion Promoting Primer

Adhesion Promoting Primer shall be single component, moisture curing polyurethane (no epoxy base shall be used) adhesion promoting primer fully sprinkled with silica sand. It shall be used if cementitious render/screed to be directly applied on top of (or hand applied version) waterproofing membrane, to increase the adhesion strength with the subsequently applied cementitious layer. Physical Properties shall be according to Table 12.2A*.

TABLE 12.2A*

Property		Characteristic Value
Chemical Base		PU
Density		1.03 g/cm³
Viscosity		110 mPas
Re-coating interval	at 23 °C / 50 % r.h.	min. 1 h.
		max. 24 h.
	at 23 °C / 60 % r.h.	min. 2 h.
		max. 36 h.
Substrate and ambient temperatures		min. 5 °C
		max. 30 °C
Permissible relative humidity		min. 40%
		max. 90%

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 13

CARPENTRY AND JOINERY

SECTION 13
CARPENTRY AND JOINERY

Generally **13.1** Timber generally shall be to **BS EN 942** and to be of mature growth, properly seasoned and sawn square. Timber shall be free from wood wasp holes, large loose or dead knots, splits or other defects that will reduce its strength. Pin holes and worm holes may be permitted to a slight extent in a small number of pieces, subject to the acceptance of the SO, provided that there is no active infestation of the materials, that the strength of the member is not impaired and that they do not appear on the finished faces of joinery work.

Timber for external use **13.1A**

(a) Species : Timber shall be either hardwood or softwood suitable for external use.

Approved softwood may be Radiata Pine, and Red or White Pine or those cited in Table NA.1 of **BS EN 942**. Approved temperate hardwoods may be Beech or Oak or those cited in Table NA.2 of **BS EN 942**. Submit the species to be used to the SO for approval.

(b) Source of Supply : Obtain timber either softwood or hardwood from a responsibly managed forest or plantation that is preferably Forest Stewardship Council (FSC) certified; where this is not available, ensure that the timber is at a minimum from a Known Licensed Source.

Submit FSC certificates and invoice copies that clearly show the FSC chain of custody number against the purchase product. Where FSC is not available, submit certificates, invoice copies and other paperwork from other systems that shows the product is either Known Licensed Source or Source in Progress to Creditable Certification.

(c) Seasoning : Moisture content to be in accordance with Clause 13.3.

Maintain the specified moisture content of the timber until preservative treatment described below is applied.

(d) Preservative : Preservatives shall be environmentally friendly, healthy and safe, acceptable preservatives include Alkaline copper quaternery (ACQ) preservatives to American Wood Protection Association (AWPA) Standards or other suitably approved preservatives. Chromate copper arsenic (CCA) is not allowed to be used subject to approval by the SO.

(e) Tropical hardwoods : Tropical hardwoods, which include species such as Meranti, Iroko, Sapele, Angre, Mahogony, Teak and Ramin, should not be used unless they originate preferably from a forest that is Forest Stewardship Council (FSC) certified or where this is not available, from a forest participating in a system designed to progress that forest towards FSC certification or equivalent authorized certification.

13.1A(1)* Timber shall be pre-treated to withstand exposure to weather and prohibit insect (e.g, termite) habitation.

Source in Progress to Creditable Certification **13.1B**

Source in Progress to Creditable Certification are forest certification systems that assist managers to achieve FSC certification. Systems including WWF Global Forest and Trade Network (GFTN) Producer Groups, the Tropical Forest Trust, Smart Step, and SGS Malaysia (Certification Support Programme) are considered as sources in progress to creditable certification.

Known Licensed Source **13.1C**

The minimum acceptable status of a timber source is "Known Licensed Source". It refers to forest certification systems (except FSC) that include a chain of custody system covering the timber being purchased (be aware that not all forest systems have this element). A list of acceptable forest certification system with a chain of custody system include the followings:

(a) Programme for the Endorsement of Forest Certification Schemes (PEFC) – General

(b) PEFC – United Kingdom

(c) PEFC – Germany

(d) PEFC – Sweden

(e) Canadian Standards Association (CSA)

(f) Cerflor (Brazil)

(g) Malaysian Timber Certification Council (MTCC)

(h) PEFC – China

Moisture content **13.3**

Calculate moisture content at the time of fabrication by the following formula:

$$\frac{\text{Wet (or supplied) Mass} - \text{Dry Mass}}{\text{Dry Mass}} \times 100 = \text{Moisture Content (percentage)}$$

The dry mass shall be determined by drying in an oven at a temperature of 103ºC ± 2ºC until the weight is constant.

The maximum permissible moisture content in timber to be incorporated into the work shall be as follows:

(a) Internal timber for use in Air Conditioned space 12%

(b) Internal timber generally 16%

(c) Timber with one face to the exterior of the building and one face to the interior (e.g. window frames) 18%

(d) External timber (e.g. fencing etc.) 20%

If these percentages cannot be attained due to local circumstances of supply and availability, the SO's attention must be drawn to the fact.

Softwood **13.5**

Softwood for carpentry to be Pine, Cedar, Spruce or China fir or other species approved by the SO. All timber shall be appropriately stamped or marked to identify origin and grade. All timber shall be kiln dried and treated according to Clause 13.1A (d), or as directed otherwise by the SO.

All softwood and softwood products shall be from a verifiable sustainable forest and shall be accredited with a certificate from the Forest Stewardship Council (FSC) or other Approved Authority. While a certificate from FSC is preferable, certificates, invoice copies and other paperwork from other systems that shows the product is either Known Licensed Source or Source in Progress to Creditable Certification are considered as acceptable certificates from Approved Authority.

Hardwood **13.6**

Hardwood and hardwood products shall only be used in special circumstances under the direction of the SO, and shall be certified as originating from a sustained resource or managed plantation as certified by the Forest Stewardship Council (FSC) or other Approved Authority.

While a certificate from FSC is preferable, certificates, invoice copies and other paperwork from other systems that shows the product is either Known Licensed Source or Source in Progress to Creditable Certification are considered as acceptable certificates from Approved Authority.

Density of hardwood shall be 720 kg/m^3 (minimum) at 15% moisture content.

Submit to the SO the following information:

(a) The species and country of origin.

(b) The name of the concessions or plantations from which these timbers originate.

(c) Copies of the forestry policies implemented by these concessions or plantations which confirm that the management of the timber resource is sustainable.

(d) Shipping documents which confirm that the supplier in Hong Kong has obtained the timber from the stated concessions or plantations.

(e) Certificate from the Forest Stewardship Council (FSC) or other Approved Authority

Hardwoods of unknown species or from unidentified sources are expressly prohibited.

Teak **13.7**

Teak, which is only permitted to be specified in special circumstances, shall have a density of 650 kg/m^3 (minimum) at 15% moisture content. They shall be accredited with a certificate from the Forest Stewardship Council (FSC) or other Approved Authority.

Flooring **13.8**

Softwood or hardwood species used for timber flooring shall be obtained from a sustainable source as previously specified.

Boarded or strip flooring shall be selected and approved hardwood, as specified, or as submitted to the SO for selection. Finished thickness shall be 20 mm (minimum).

Emission of formaldehyde from the approved proprietary products shall not exceed 0.13 mg/m^3 air.

Wood block flooring **13.9**

Wood block flooring shall be approved high density resin bonded fibreboard flooring or other approved hardwood as specified. Resin shall conform to Class E1 under **BS EN 13986**. Finished thickness shall be 20 mm (minimum). Blocks shall be 300 mm x 50 mm in size and colour matched.

Parquet flooring **13.10**

Wood parquet flooring shall be obtained from a sustainable source as previously specified. Each block shall be 120 mm x 25 mm in size and 8 mm thick, and shall be tongued & grooved.

Weather boarding **13.11**

Hardwood weather boarding shall be 150 mm wide and tapering from 25 mm to 10 mm thick and shall be:

(a) Sawn boarding or boarding wrot on one face and two edges with horizontal joints lapped 30 mm.

(b) Boarding as (a) but with wider edge rebated with joints lapped 20 mm.

Plywood **13.12**

Plywood shall be of the following grades, as specified:

(a) "Grade 1 veneer" - hardwood faced, as specified, for natural finish.

(b) "Grade 2 veneer" - lauan faced for painting.

Generally the bonding adhesive between veneers shall be resin adhesive of durability class H2 in accordance with **BS 1203**. Adhesive shall conform to the requirement in Clause 13.29.

Nominal standard thicknesses of plywood shall be 3, 4, 5, 6, 9, 12, 15, 18 and 25 mm.

Plywood containing hardwoods of unknown species or from unidentified sources are expressly prohibited from use. Use only plywood and plywood products made from softwoods or temperate hardwoods that originate from the Forest Stewardship Council (FSC) certified forests or other Approved Authority.

While a certificate from FSC is preferable, certificates, invoice copies and other paperwork from other systems that shows the product is either Known Licensed Source or Source in Progress to Creditable Certification are considered as acceptable certificates from Approved Authority.

13.12A* The veneer for use in natural state shall be free from knots, wormholes, split, dote, glue stains or other defects.

Marine plywood **13.13** Marine plywood shall be to **BS 1088** bonded with durability class of D3 or D4 in **BS EN 204** adhesive between plys as in Clause 13.29.

Blockboard **13.14** Blockboard shall be Grade 2 veneer for painting, and bonded with adhesive as in Clause 13.29.

Hardboard **13.15** Hardboard shall be to **BS EN 316**, **BS EN 622-1** and **BS EN 622-2**.

Insulating board **13.16** Insulating board (Softboard) shall be to **BS EN 316**, **BS EN 622-1** and **BS EN 622-4**.

Wood chipboard **13.17** Wood chipboard shall be unsanded or sanded board to **BS EN 309** and **BS EN 312**. Veneered chipboard shall be an approved proprietary brand to **BS EN 309** and **BS EN 312**. All wood chipboards shall be low formaldehyde emission chipboard (Class E1) unless permitted otherwise by the SO, or polyurethane - based chipboard with zero formaldehyde emission. Any boarding shall be used in wet areas such as kitchens or bathrooms shall be High Moisture Resistant board to **BS EN 31**6 and **BS EN 321**.

Medium Density Fibreboard (MDF) **13.17A** Board type shall be moisture resistant grade (MDFMR) with density in excess of 600 kg/m^3 to **BS EN 316** and **BS EN 622-5**.

13.17A(1)* MDF board used shall comply with E1 formaldehyde emission limit of less than 8mg/100g when tested in accordance with EN 120. Certificate to demonstrate compliance shall be submitted.

The fire performance of acoustic wall panel shall be classification B or above in accordance with BS EN 13501-1:2007.

Acoustic panel shall comply to BS476 Part 6 & 7 Class I Fire Test Certificate to demonstrate compliance shall be submitted.

Glass fibre **13.18** Glass fibre insulating quilt shall be light-weight bonded mat weighing 12 kg/m^3 uncompressed.

Semi-rigid resin bonded glass fibre slab **13.19** Glass fibre insulating board shall be semi-rigid resin-bonded glass fibre weighing 45-48 kg/m^3.

P.V.C. or acrylic sheet **13.20** PVC or acrylic sheet shall be clear, translucent or coloured, as specified, and to be approved by the SO.

Laminated plastic sheet

13.21 Laminated plastic sheet less than 2 mm thick shall be to **BS EN 438** Part 3. Class HDS (horizontal heavy-duty standard), HDF (horizontal heavy-duty flame-retardant), HDP (horizontal heavy-duty postforming), HGS (horizontal general-purpose standard), HGF (horizontal general-purpose flame-retardant), HGP (horizontal general-purpose postforming), VGS (vertical general-purpose standard), VGF (vertical general-purpose flame-retardant), VGP (vertical general-purpose postforming) as specified.

Acoustic tiles

13.22 Acoustic tiles shall be of an approved proprietary brand meeting the requirements of **BS EN 13964** manufactured from the following materials:

(a) Wood or other organic fibre insulating board to BS EN 622, 12 mm (Minimum) thick for 300 mm x 300 mm tiles and 15 mm (minimum) thick for 400 mm x 400 mm tiles.

(b) Mineral fibre or wool insulating board 12 mm (minimum) thick for 300 mm x 300 mm tiles and 15 mm (minimum) thick for 400 mm x 400 mm tiles.

(c) Approved multi-purpose, dimensionally stable building board 6 mm (minimum) thick.

Tiles shall have a plain, perforated or fissured surface with a factory applied decorative finish. The edges shall be square, bevelled, or bevelled and grooved to suit the suspension system.

Provide a certificate from the manufacturer confirming that the tiles are asbestos free.

Tiles shall be manufactured with low emission materials conforming to European E1 emission standard.

The acoustic tiles shall be accompanied with relevant test certificates or reports regarding the acoustic performance, issued by an accredited laboratory.

Proprietary suspended ceiling systems

13.23 The suspended ceiling system shall be an approved proprietary system meeting the requirements of **BS EN 13964** and of one of the classes of exposure to be determined by conditions set out in Table 13.1.

TABLE 13.1
Classes of exposure

Class	Conditions
A	Building components generally exposed to varying relative humidity up to 70% and varying temperature up to 25ºC but without corrosive pollutants.
B	Building components frequently exposed to varying relative humidity up to 90% and varying temperature up to 30ºC but without corrosive pollutants.
C	Building components exposed to an atmosphere with a level of humidity higher than 90% and accompanied by a risk of condensation.
D	More severe than the above.

The suspension system shall be manufactured from one of the following materials:

(a) Galvanized mild steel.

(b) Aluminium.

(c) A combination of galvanized mild steel and aluminium.

Metal framing components, suspensions and connecting elements shall be protected against corrosion according to Table 13.2.

TABLE 13.2

Classes of corrosion protection of metal substructure components and membrane components

Class according to Table 13.1	Profiles, suspensions[a], connecting elements[a] and membranes	
	Components made of steel	Components made from aluminium
A	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to **BS EN 10346**[b c]. Products with electroplated zinc coating flat ZE25/25 according to **BS EN 10152**[c]. Continuously organic coated (coil-coated) products of corrosion protection (interior) category CPI2 for the exposed side according to **BS EN 10169:2022**[f] (e.g. coating system ZE15/15-HDP25-2T-CPI2).	No additional corrosion protection required
B	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to **BS EN 10346**[b c]. Products with electroplated zinc coating flat according to **BS EN 10152** with or without an additional organic coating[d] as follows[c]: ZE25/25 + 40 µm per face[e], ZE50/50 + 20 µm per face[e] or ZE100/100 without OC. Continuously organic coated (coil-coated) products of corrosion protection (interior) category CPI2 for the exposed side according to **BS EN 10169:2022**[f] (e.g. coating system ZE15/15-HDP25-2T-CPI2).	No additional corrosion protection required or coil coating according to **BS EN 1396**: corrosion index 2a
C	Products with a continuously hot-dip metal coating Z100, ZA095 or AZ100 according to **BS EN 10346**[b c] with an additional organic coating[d] of 20 µm per face. Products with electroplated zinc coating flat according to **BS EN 10152** with an additional organic coating[d] as follows[c]: ZE25/25 + 60 µm per face[e] , ZE100/100 + 40 µm per face.	Anodising[c] (15 µm < s < 25 µm) or coil coating according to **BS EN 1396**: corrosion index 2a
D	Special measures depending on use and corrosion action. Minimum corrosion protection according to Class C. Additional measures as required.	Anodising[c] (s > 25 µm) or coil coating according to **BS EN 1396:**corrosion index 2b

a Round steel wires used as suspensions or part of a suspension shall meet the requirements of **BS EN 10244-2** (Zinc or Zinc alloy coating on steel wire).
b **BS EN 10346** replaces **BS EN 10327.**
c Any equivalent corrosion protection leading to a similar level of protection is permitted.
d Coating of exposed parts with zinc compatible organic coating according to **BS EN ISO 12944-3** applied by a post-painting process or equivalent coil coating according to **BS EN 10169:2022**.
e Applies only to membrane components.
f Applies only to "capping" material for substructure components.

The substructure (suspension system) shall be classified in accordance with its deflection limits as given in Table 13.3. See para. 4.3.2 of **BS EN 13964** for testing criteria and methodology.

TABLE 13.3
Class of deflection

Class	Maximum deflection in mm[A]
1	L^B / 500 and not greater than 4.0

2	L^B / 300
3	No limit

A The maximum deflection is the accumulative value of the deflection of the substructure component and the deflection of the membrane component
B *L* is the span in mm between the suspension components or the suspension points

Aluminium sections shall be anodised where exposed. The panel grid shall be constructed of exposed tee or concealed 'T', 'Z' or other approved sections. Hangers shall be steel wires not less than 2 mm diameter, or straps, rods or combination of sections designed to facilitate the adjustment of grid levels, support the weight of the ceiling and all fittings and attachments. Fixing to soffits shall be by means of approved sockets, anchors or other fixing devices cast into the slab or approved proprietary plugs or drill-anchors.

The system shall be so designed to facilitate the removal of at least 10% of the tiles without disturbing the remainder.

Provide matching edge trim to the perimeter of suspended ceilings.

Submit samples of the panel grid complete with acoustic ceiling tiles for approval.

13.23A* Suspension System

The ceiling shall consist of suspension wire in galvanized steel or hangers, anchorages and leveling devices, runners, couplings and clips, wall mouldings, joint trimmings and other accessories necessary for suspending from the structural ceiling, making levelling adjustment, and the proper assembling of the ceiling system.

Unless otherwise indicated, works to be built into concrete or masonry shall be anchored with shop-welded-on galvanized steel strap anchors or galvanized steel hanger bolts.

Nails **13.24** Nails shall be steel nails to **BS 1202**: Pt. 1, with "bright" finish, unless otherwise specified. The nail and its coating shall not contain Arsenic, Cadmium, Copper, Lead or Mercury.

Nail lengths shall be not more than the total thickness of sections to be joined less 5 mm, or not less than twice the thickness of section through which nails are driven.

Where the thickness of the outer section through which nails are being driven is less than half that of the section to which nailing is being done, the depth of penetration of the nails into the latter shall be not less than 10 diameters of the nails being used.

Screws **13.25** Wood screws shall be brass, stainless steel, alloy or other non-corroding metal with countersunk heads, unless otherwise specified. Steel screws shall only be used for temporary work. The proper dedicated screws shall be used for all Particle-board fixing.

Screw lengths shall be not more than the total thickness of sections to be joined, less 5 mm, or not less than one and a half times the thickness of section through which screws are driven.

Where the thickness of the outer section being screwed is less than half that of the section to which screwing is being done, the depth of penetration of the screwing into the latter shall be not less than the thickness of the outer section.

Screw cups shall be brass cups or stainless steel.

Masonry nails **13.26** Do not use masonry nails or drive pins without approval.

Explosive cartridge fixings **13.27**

Obtain approval before using explosive cartridge operated fixings. All fixings shall be in accordance with the Factories and Industrial Undertakings (Cartridge-Operated fixing tools) Regulations. Use tools, normally of the indirect acting type, plus pins and cartridges which correspond with the manufacturer's specifications for that tool. A tool shall only be used by a person holding a certificate of competency specifying the maker and model of the tool on which he has been successfully trained.

Plugs **13.28**

Plugs for fixing to hard materials shall be proprietary plugs of plastic, soft metal, fibre or similar.

Fixing to friable materials, plasterboard and the like shall be proprietary fixings specially designed for that situation.

The use of wood plugs shall not be permitted.

Adhesive **13.29**

Adhesive for wood shall be as follows:

(a) For internal use: thermoplastic resin wood adhesives classified as durability class of D1 or D2 in BS EN 204 in accordance with moisture content of timber as given in Clause 13.3.

(b) For external use or internal use under very damp conditions: thermoplastic resin wood adhesives classified as durability class of D3 or D4 in BS EN 204.

(c) Formaldehyde Emission shall be of Class E1 under BS EN 13986.

Where the temperature exceeds 25°C, a “warm-setting” grade of adhesive shall be used.

The use of animal glues shall not be permitted.

The following requirements shall be complied with:

(a) VOC content limits on regulated adhesives stipulated in the Air Pollution Control (VOC) Regulation of Hong Kong.

(b) Shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1- trichloroethane and carbon tetrachloride).

(c) Shall contain no more than 0.01% by wet weight of formaldehyde.

(d) Shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

Resin for MDF panels **13.29A**

All urea formaldehyde bonded MDF panels and MUF mouldings shall be manufactured with low emission resins conforming to Class E1 of **BS EN 13986** emission standard.

Wood preservative **13.30**

Wood preservative shall be an approved proprietary brand exterior grade where completely concealed, or not decorated and colourless, coloured or suitable for overpainting where likely to be exposed or in contact with a painted finish.

Wood preservative to external timber **13.30A**

Wood preservative to external timber shall be applied as follow:

(a) Preparation : Timber shall be free from dirt and surface moisture.

(b) Application of Preservative: Apply by pressure impregnation in accordance with **BS 8417.**

Apply preservative in a manner that is not hazardous to health. Adhere strictly to the manufacturer’s instructions.

(c) Cutting and Machining : Whenever possible, all cutting, planning, boring, drilling, notching or any other machining or manual operation shall be completed prior to preservative treatment.

(d) Incising : For certain timbers such as Douglas Fir which are difficult to impregnate, make 20 mm deep incisions coverage of 650 per m^2 in the direction of the grain all in accordance with **BS 144.** This method shall only be used on timber sections exceeding 80 mm thickness.

(e) Creosote Application : For timber where impregnation is not suitable and a paint finish is not required, when approved apply 2 coats of creosote in accordance with the manufacturer's instructions.

(f) Guarantee : Obtain a guarantee of 30 years for timber components against rot, insect attack and fungal decay.

(g) The product shall not contain any heavy metals or their compounds as listed below:

(i) Arsenic
(ii) Cadmium
(iii) Copper
(iv) Lead
(v) Mercury

Mosquito gauze **13.31** Mosquito gauze shall be one of the following:

(a) Plastic covered glass fibre 7 x 7 mesh per 10 mm^2.

(b) Stainless steel wire 11 x 11 mesh per 10 mm^2.

(c) Copper wire 11 x 11 mesh per 10 mm^2.

Door & panel **13.49** Softwood or hardwood species used for timber doors and panels shall comply with the following:

(a) Formaldehyde Emission: All wood panels shall be of Class E1 under **EN 13986** in respect of formaldehyde emission.

(b) The approved proprietary products shall not contain any heavy metals or their compounds as listed below:

(i) Arsenic
(ii) Cadmium
(iii) Copper
(iv) Lead
(v) Mercury

(c) The following substances shall not be added during manufacturing: elemental chlorine, fluorine, PCP (pentachlorophenol) and tar oils containing benzo(a)pyrene.

(d) The approved proprietary products shall have no flame retardant of polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs) or short-chain chlorinated paraffins added as formulated components.

The following requirements shall also be complied with for wood panels:

(a) The content of free formaldehyde in adhesives used in the product shall not

exceed 0.5% by weight of the adhesive.

(b) Requirements of wood or wooden materials: the approved proprietary products shall meet one of the following requirement:

(i) 40% of the wood material is from recycled/waste wood;

(ii) The wood material obtains sustainable forest management certification such as Forest Stewardship Council (FSC), PEFC (Programme for the Endorsement of Forest Certification schemes) or equivalent.

Door & frames general

13.52 Door frames shall not be used as formers for door opening construction unless with the permission of the SO, and never when proprietary door sets are required in the Contract. In all such circumstances, templates or formers must be used. The adoption of timber doorsets may be accepted subject to the approval of the SO.

13.52A* Door frame or perimeter acoustic shall be made of rigid, flexible and flame retardant PVC or silicon rubber and tested and approved for use on fire rated doors.

Fire resisting timber door

13.61 Fire resisting timber doors should be flush door as described above, including frames, hinges door closers and any other hardware and shall comply with **BS 476** Part **20-23** or Classification I1 of **BS EN 1634-1**.

Proprietary fire doors should be tested in accordance with **BS 476** Part **20-23 or** Classification I1 of **BS EN 1634-1** and to the approval of the SO. Test report shall be provided to indicate that the material, product or construction is capable of resisting the action of fire for the specified period.The test shall be carried out and the test report shall be prepared by an Accredited Laboratory.

13.61A* (1) The fire rated doors shall be successfully tested with or without a latching mechanism in BS 476: Part 22 or BS EN 1634-1 fire test and BS EN 1634-3 smoke test. A test certificate issued by a HOKLAS accredited laboratory or other laboratory accreditation bodies which have reached mutual recognition agreements/ arrangement with HOKLAS certifying the required fire resisting rating of the door assemblies.

(2) Where specified, the vision panels shall be clear laminated glass for FD30 and FD60 fire doors.

(3) Smoke control testing shall be to BS 476 Section 31.1 and smoke control doors shall achieve a leakage rate of not more than 3m3/m/hour over the length of the head and jambs only at 25Pa at ambient temperature. Smoke seals shall be located so as not to affect the ease of operation or fire resistance of the assembly. Unless otherwise specified, all fire rated doors shall also be designated as smoke control doors.

(4) Fire and/or smoke control assemblies shall satisfy the requirements of relevant statutory and regulatory bodies, BS8214 and the relevant Clauses hereof.

Smoke and intumescent seals

13.62 Folding or swing fire doors shall incorporate proprietary smoke seals and intumescent strips where necessary to attain the requirements of **BS EN 1634-3, BS EN 14600, ISO 5925-1, UL 1784, AS 1530:Part 7; or BS 476 Pt. 20-23**.

13.62A* Smoke seal shall be made of rigid, flexible and flame retardant PVC or silicon rubber and tested and approved for use on fire rated doors.

Acoustic doors **13.63** Acoustic doors shall be either solid core doors or composite core doors with air-tight seals to all junctions with frames and recessed threshold. Seal types shall be submitted to the SO for approval unless specified in the Contract. Airborne sound insulation shall be tested to **BS EN ISO 10140-1, 2 & 5** or **ASTM E413** and **ASTM E90.** Field ratings shall be tested to **ASTM E336** and **ASTM E413.** The Contractor shall guarantee both laboratory and field performance. The doors shall be accompanied with relevant test certificates or reports regarding the acoustic performance, issued by an accredited laboratory.

13.63A* Acoustic seals generally shall be of concealed, mortised types, except that surface mounted seals may be accepted within plant rooms and the like. Bottom seals shall be of suitable, automatic rising types. Seals shall be located so as not to affect ease of operation or the fire resistance of any fire rated assembly.

Glued laminated timber **13.69** Glued laminated timber shall be to **BS EN 14080**.

Cross laminated timber **13.70** Cross laminated Timber shall be to **BS EN 16351**.

Engineered bamboo products **13.71** Engineered Bamboo products shall be to **BS ISO 23478**.

Fire resisting ceiling system (fire barrier) **13.72***

(1) Any exposed surfaces of the fire barrier shall be applied with 2 coats of proprietary synthetic paints.

(2) The fire rated ceilings shall be non-combustible, proprietary, suspension type ceiling systems allow for the protection to or from services contained within the ceiling void. It shall achieve the required FRP according to BS 476 Part 20 to 24 integrity and insulation which shall be capable of withstanding fire from inside or outside. It shall also comply with the standard as required by the latest HK Regulations and Fire Codes.

(3) The fire-resistant sheet for the ceiling shall be with fully insulated enclosure with specified FRP as accepted by FSD and BD. The fire-resistant sheet shall be heavy duty type which shall be made of tough and versatile material. It shall be asbestos free and formed under high pressure to a high-quality fibre silicate board. The fire-resistant sheet shall be proved integrity and stability in fire conditions, resistant to flame penetration, of low transference of heat by radiation, significant sound reduction properties, physically and mechanically durable, non-combustible, of high impact resistance and of high mechanical strength to low weight ratio, unaffected by attacks by pests, mould and humidity. The overall thickness of the system shall not exceed 88mm for 2 hours FRP and 126mm for 4 hours FRP.

(4) The fire-resistant sheet shall be of minimum 19mm thick with a tolerance of ± 1mm and backed by minimum 75mm wide filler of the same material at junction where different sheet joins. Minimum thickness of 50mm mineral wool of density 200kg/m3 shall be installed at the back of the sheet to achieve the required insulation integrity period of the whole fire rated enclosure system.

(5) The fire-rating required shall be at least 1 hour FRP and shall conform to the integrity and insulation requirement under B.S. 476 Part 22 and/or specified in Drawings.

(6) The fire resisting enclosure shall be proved integrity, insulation and stability in fire conditions according to the fire-resistant period requirement resistant

to flame penetration, of low transference of heat by radiation, significant sound reduction properties, physically and mechanically durable, non-combustible, of high impact resistance and of high mechanical strength to low weight ratio.

(7) Provide sub-ceilings with FRR value where necessary to meet statutory requirements. They shall be (i) "Durasteel"; or (ii) "Supalux"; or (iii) "Promat". Sub-ceiling assemblies to be located above the suspended ceilings and suspension integrated with that of the suspended ceilings and all coordinated to suit.

Suspended Ceiling to underside of Building **13.73*** Exterior suspended ceiling system shall be typhoon proof type. The ceiling panels shall be powder coat finished aluminium alloy non-perforated panels or of aluminium with 3-coat PVF2 coating, stormproof but easily demountable for maintenance of services at ceiling void

(a) Suspension system consists of min 1.25mm thick galvanized steel Z profile which is interconnected with 2.0mm thick galvanized steel, both flanges pierced primary angle.

(b) The whole system shall be suspended to concrete soffit by means of G.M.S. angle sub-frame.

External doors **13.74*** All doors facing external areas excluding the main entrance doors, shall be constructed of stainless steel (grade 316). The doors shall include ventilation louvers and fire dampers (as appropriate), locking device, self-closing device and other ironmongeries, stainless steel angle door frame (of grade 316), local buzzer and door contact connected/linked back to the security office/rooms/booths and control room for security monitoring.

Doors shall be weather-right and constructed to withstand severe weather conditions.

Doors shall be seamless or continuously welded with at least 3 nos. heavy-duty stainless-steel security hinges per door leaf, with door and door frame reinforced as necessary.

Refer to 13.61 for additional requirements for fire rating.

Integrated metal ceiling system for clinical areas **13.75*** The suspension system shall consist of GMS hanger rods and fixing brackets, GMS U-profile, hanger clips for T-profiles, main T-profiles and cross T-profiles and exposed extruded aluminium profile sections in powder coated finish to match with the ceiling panels.

Maximum deflection of the installed system shall be in accordance with BSEN l3964:20 1 4 and with no apparent deflection under normal circumstances.

All materials shall be designed and installed in accordance with BSEN 13964:2014, relevant codes, regulations, ordinances and manufacturer's recommendations.

Suspended acoustic metal ceiling system for non-clinical areas and circulation areas **13.76*** Ceiling panels shall be minimum 0.7mm thick aluminium powder coated in standard RAL colours with 4 debated square edges and backed with black-faced acoustic inlay to completely fill the tiles. Perforation shall be of 0.7mm diameter holes resulting in a minimum of I.5% open area.

All materials shall be designed and installed in accordance with BSEN 13964:2014, relevant codes, regulations and ordinances.

Airtight suspended metal ceiling system **13.77*** Air tight suspended ceiling system shall be tested for performance on air-tightness by an independent testing laboratory and the air-leakage rate of the ceiling system shall be:

Pressure differential (Pa)	Leakage rate (m'/h)
5Pa	<2
l0Pa	<2
25Pa	<4
50Pa	<7

All materials shall be designed and installed in accordance with BSEN 13964:2014, relevant codes, regulations and ordinances.

Anti-fungal seamless ceiling for operating theatre **13.78*** The ceiling shall be finished with anti-septic coating.

Timber doors **13.79*** Proprietary timber doors shall be solid cored timber flush doors, faced with high density 650kg/m' MDF, and provided with or without glazed viewing panels. GM.S. door frames shall be fully covered with non-PVC vinyl protective door frame guard. Non-PVC vinyl kick plate & push plate of doors shall be chemical and stain resistant and with bevelled edges. Timber doors shall have the same acoustical performance as required for the internal wall of individual rooms. Where required, the vision panels shall be of clear tempered glass.

Timber is obtained from a responsibly managed forest or plantation that is preferably Forest Stewardship Council (FSC) certified or from either Known Licensed Source or Source in Progress to Creditable Certification as per Clauses 13.01.3 and 13.01.2 of the General Specification for Building (2017 Edition) respectively. All certification shall bear a FSC or relevant chain of custody (CoC) number which tracks the certified material through the production process — from the forest to the consumer, including all successive stages of processing, transformation, manufacturing and distribution.

Proprietary lead lined doors **13.80*** (1) In addition to the requirements as stipulated in BPS Section 13.79 Timber doors above, lead lined doors shall incorporate lead sheeting which shall extend through the door frame with adequate overlapping with adjacent walls to form an effective barrier to radiation in all directions. The lead thickness required shall meet the required radiation shielding for the rooms concerned. Lead shall be in 2 sheets sandwiched between the MDF covering to the core and the tempered hardboard surface. Hardwood lead lined door frames specifically recommended by the door manufacturer shall be used.

(2) The vision panels shall be of a density that the clear glass has an equivalent lead thickness of 3mm and capable of shielding X-ray generated at peak voltage of 200kv. The entire door set shall provide full X-ray protection, with joints and insides of frames fully lined with lead to meet the Radiation Board requirements.

Auto-slide hermetically-sealed door and door control system **13.81*** (1) Auto-slide hermetically-sealed door system shall be in smooth and silent horizontal operation, with adjustable opening and closing speed, and automatic stop and reverse function upon resistance in closing action.

Proprietary auto-slide hermetically-sealed door and door control system performance requirements shall include the following: -
Materials

a) Door frame and door blade surrounding shall be of anodized aluminium profile. Frame profile is 3-sided and blind fixed to a finished wall opening. The door blade shall seal the opening to this profile with combined doorstop and replaceable gasket.

b) Door core shall be made of injected CFC-free polyurethane and MDF or other materials and finished with hygienic hard plastic laminate or 1mm thick plastic laminate.
c) Door blade shall be completely flush with door surface on both sides and fitted with exchangeable rubber gasket for hermetic closing on the floor and wall frame profile.
d) Vision panel shall be double glazed safety glass, minimum 900 x 900mm in size or otherwise required to suit user's operational need and finish with door surface on both sides with the door blade.
e) Door handles shall be provided on both sides for easy manual operation; opening and lifting the door shall be in one movement.
f) Finished floor in the opening and in the sliding, space shall be level; maximum deflection is l mm.
g) Exchangeable rubber gasket shall be provided around door leaf to ensure hermetic sealing to achieve the following leakage rates:

Pressure differential (Pa)	Leakage rate (m'/h)
5Pa	<2
l0Pa	<2
25Pa	<4
50Pa	<7

(2) Door Operators
a) Operator used shall be suitable for weight of the doors.
b) Full electric driver-control-unit shall complete with programmable and adjustable opening speed, closing speed, hold opening time, width of passage and obstacle safety stop/reverse function.
c) The housing of operator shall be sealed against duct, dirt and moisture. The cover shall be clear anodized aluminium or powder coated in standard RAL colour and shall be robust and easy to open for maintenance.
d) Interlocking system shall be available for two or more doors, and compatible with other automatic door systems. When one door is in open condition, the hand/foot operator of the other door shall become inoperable. Interlocking shall be adjustable by means of key-switch at each door.

(3) Electronic Control
The operation and switching of the sliding operator shall be controlled by self-contained, solid state integrated circuit.

(4) Activation Device
a) Control of electric automation shall be by means of push plate (i.e. footswitch) or proximity 6ensor.
b) The push plate (footswitch) shall be of stainless-steel grade 314 and be robustly constructed. The contact plate shall be not less than 90x200mm long so as to provide convenient foot contact. This shall be installed at a height above finished floor level to be confirmed with the Supervising Officer before installation.
c) The proximity sensor shall be flush wall mounted, of suitable material for frequent cleaning and disinfection, and with adjustable sensing field between 100-500mm or otherwise instructed by the Supervising Officer. This shall be installed at a height above finished floor level to

be confirmed with the Supervising Officer before installation.

(5) Safety Sensors

Safety edge shall be provided to stop and reverse the door upon resistance in closing action.

a) At least two horizontal infrared barriers shall be provided at the door frame at a height above finished floor level to be confirmed by the Supervising Officer;
b) Overhead lrifrared detection and monitoring sensor with adjustable sensing field shall be provided at the open side of the door. The safety sensor shall halt the door elosing operation and return to full opening if obstacles are detected upon closing; and
c) Additional overhead infrared presence safety sensor shall be installed above the door opening on both sides and the end as add-on safety sensor. The presence detection zone shall be adjustable or shut off by switch adjustment.

Combinations / options of safety sensors shall be provided to suit location as necessary.

(6) Locks and handles

The auto-sliding door system shall be able to connect with fail-safe type electro-magnetic locking device. Door handle of the system shall be lever handle for door lift up and serves as handle purpose.

(7) Power failure operation

The sliding door shall be fail-safe type, unlocked and be manually operated upon actuation of fire alarm or power breakdown. Break glass or emergency switch shall be provided to switch the door to manual operation in case of emergency.

(8) Function selector

Each auto-sliding system shall be equipped with one 3-position key switch with operating modes including automatic mode, manual mode and interlocking deactivated mode. In general, function selector shall be placed at a conspicuous location and at a height above finished floor level that can be accessible at a standing position or otherwise instructed by the Supervising Officer.

(9) Fire services alarm signal interfacing

The auto-sliding door serving also as emergency exit shall be unlocked and manually operated in case of trigger of fire alarm signal of the building fire services control panel. Rechargeable fail-safe batteries shall be provided, if required, to open the sliding door automatically for emergency exit in case of trigger of fire alarm signal.

(10) In addition to the above requirements, the following requirements shall also apply to auto-slide hermitically-sealed lead-lined door and door control system:

a) Thickness of lead in-lay panel may vary from 3mm to 5mm to suit ihe use at locations as specified in Part II of the Employer’s Requirements or otherwise as directed by the Supervising Officer.
b) Door panel of the system shall be core faced or of injected polyurethane with high pressure laminate on both sides with lead in-lay panel.
c) Anodized aluminium profile door frame shall be of the same lead equivalence as the adjacent wall and have protective lead overlapping

with the adjacent wall.

Automatic internal sliding door control system

13.82*

(1) Automatic internal sliding door operator for accessible toilet shall incorporate magnetic technology with low-energy mode, smooth and silent horizontal operation, adjustable hold-open time, permanent open and automatic closing. Cover of the operator shall be anodized aluminium or powder coated in standard RAL colour and shall be robust and easy to open for maintenance.

Control of door operations shall be integrated into master control panels (inside and outside) incorporating proximity hand sensors and/or control buttons in large format with integral LED illuminating indicators for door open/close and lock/unlock, keyed program switches for different operation modes, clear indication of room status (i.e. vacant or occupied), illuminated operation instructions, emergency door release buttons, etc. Adequate safety edge sensors shall be provided to stop and reverse the door upon resistance in closing action.

(2) The sliding door operator shall be connected with rail-safe electro-magnetic locking device that the door shall operate as a manual sliding door in case of emergency or upon power failure with a minimum effort in compliance with the requirements of Barrier Free Access, i.e. with a horizontal opening force less than 22N. Motion sensor shall be provided and linked with the door operator for idling detection (time-adjustable) to automatically release the door lock.

Auto-swing door and door control system

13.83*

Proprietary auto-swing door control system shall be provided with the system with air-sealed performance as required in S13.81 except for the auto-swing requirements stated hereafter:

(a) Supply and install electro-hydraulic auto-swing door system, with smooth and silent heavy-duty operation, AC connected, individually adjustable opening and closing speed, adjustable hold open time, automatic stop and reverse function upon resistance in closing and automatic stop in opening action or upon manual operation. Operator cover shall be anodized or powder coated aluminium in selected colour.

(b) The auto-swing door system shall be suitable for installation on the proprietary air-sealed and/or fin rated doors, which shall fulfil relevant standards. Assessment report against BS 476 standard by recognized laboratory shall be submitted.

(c) Door panel shall be completely flush and finished with hygienic hard plastic laminate or l mm thick plastic laminate with full range of colour and pattern of plastic laminated sheet under the manufacturer's production line for the selection of the Supervising Officer.

(d) Vision panel shall be double glazed safety glass, minimum 900 x 900mm in size or otherwise required to suit user's operational need.

(e) Exchangeable rubber gasket shall be provided around door leaf to ensure air sealing to achieve the following leakage rales:

Pressure differential (Pa)	Leakage rate (m /h)
5Pa	<2
10Pa	<2
25Pa	<4
50Pa	<7

(f) Provide complete installation, including final connection to fire alarm system, with all wiring in concealed conduits.

Woodwool Acoustic Ceiling panel

13.84*

To fulfil the requirements listed below:

Material	1mm wood wool bound with white Portland cement and mineral powder (EN 13168)
Weight	Min. 15 kg/m2
Dimensional Stability	Thickness and width tolerance ±1mm (EN 823, EN 822) and Squareness ≤2mm/m (EN 824)

Acoustic absorption test result under EN ISO 354: 2003

Reaction to Fire	Class B-s1, d0 (EN 13501-1)
Water Vapour Diffusion Resistance Factor	μ = 5 (EN 12086)
Declared Thermal Resistance	0.30 m2K/W
Compressive stress at 10% deformation	Not less than 300KPa (UNI EN 826)
Light Reflection	50.7-74% (Colour white 05/15)
Release of Formaldehyde	Class E1 (EN 717-1)
Release of asbestos	It does not contain asbestos
Impact Resistance	Class 1A (EN 13964 Annex D) according to the manufacturer recommended installation
Standard	EN 13168 and EN 13964, CE-marked
Environment Friendliness	The wood used comes from sustainably managed forests (PEFC™ or FSC® Chain of Custody certification). Products are manufactured in an environmentally friendly process and can be recycled
Quality Management System Certification	It is certified by ANAB-ICEA for the eco-biocompatibility of materials and the production process. It is manufactured by EN ISO 9001:2008 certified company.

Acoustic Hanging Baffles/Panel **13.85*** The proprietary acoustic system shall be made from 100% high performance glass wool. All panels shall be in compliance with the following requirements or equivalent standard.

Characteristic	Requirement
Length / Width	maximum span 1200x2400mm

Acoustic Properties

Centre Freq. Hz	125	250	500	1000	2000	4000
Absorption Coeff.	0.55	0.80	0.90	1.00	1.00	1.00

*200mm air space behind, per ISO 354: 2003: Measurement of sound absorption in a reverberation room.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 14

IRONMONGERY

SECTION 14
IRONMONGERY

Standard **14.4** Unless more stringent standards are specified, all architectural ironmongery shall comply with the current editions of following British/European/National Standards:

Standard	Title
BS EN 179*	Building hardware. Emergency exit devices operated by a lever handle or push pad, for use on escape routes. Requirements and test methods.
BS EN 485-1+A1	Aluminium and aluminium alloys - Sheet, strip and plate - Part 1: Technical conditions for inspection and delivery
BS EN 485-2	Aluminium and aluminium alloys - Sheet, strip and plate - Part 2: Mechanical properties
BS EN 485-3	Aluminium and Aluminium alloys - Sheet, strip and plate - Part 3: Tolerances on dimensions and form for hot rolled products.
BS EN 485-4	Aluminium and aluminium alloys - Sheet, strip and plate - Part 4: Tolerances on shape and dimensions for cold-rolled products.
BS EN 515	Aluminium and aluminium alloys - Wrought products - Temper designations.
BS EN 573-1	Aluminium and aluminium alloys. Chemical composition and form of wrought products. Part 1: Numerical designation system.
BS EN 573-2	Aluminium and aluminium alloys. Chemical composition and form of wrought products. Part 2: Chemical symbol based designation system.
BS EN 573-3	Aluminium and aluminium alloys. Chemical composition and form of wrought products. Part 3: Chemical composition and form of products.
BS EN 573-5	Aluminium and aluminium alloys. Chemical composition and form of wrought products. Codification of standardized wrought products
BS EN 912	Timber fasteners. Specifications for connectors for timbers.
BS EN 1125*	Panic exit devices.
BS EN 1154*	Door closing devices.
BS EN 1155*	Electrically powered door holders.
BS EN 1158*	Door co-ordinators.
BS EN 1172	Copper and copper alloys. Sheet and strip for building purposes.
BS EN 1303	Cylinders for locks.
BS EN 1403	Corrosion protection of metals. Electrodeposited coatings. Method of specifying general requirements.
BS EN 1461	Hot dip galvanized coatings on fabricated iron and steel articles, specifications and test methods.
BS EN 1527	Sliding door gear.
BS EN 1634-1	Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Fire resistance test for door and shutter assemblies and openable windows.
BS EN 1634-2	Fire resistance and smoke control tests for door, shutter and openable window assemblies and elements of building hardware. Fire resistance characterisation test for elements of building hardware.
BS EN 1634-3	Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware. Smoke control test for door and shutter assemblies.
BS EN 1652	Copper and copper alloys. Plate, sheet, strip and circles for general purposes.

BS EN 1654	Copper and copper alloys. Strip for springs and connectors.
BS EN 1670	Corrosion resistance.
BS EN 1906	Building hardware. Lever handles and knob furniture. Requirements and test methods.
BS EN 1935*	Single axis hinges.
BS EN 2284	Specification for sulfuric acid anodizing of aluminium and wrought aluminium alloy.
BS EN 10029	Hot-rolled narrow steel strip. Tolerances on dimensions and shape.
BS EN 10048	Hot rolled narrow steel strip. Tolerances on dimensions and shape.
BS EN 10051	Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels. Tolerances on dimensions and shape.
BS EN 10095	Heat resisting steels and nickel alloys.
BS EN 12051	Door and window bolts.
BS EN 12163	Copper and copper alloys - Rod for general purposes.
BS EN 12164	Copper and copper alloys - Rod for free machining purposes.
BS EN 12166	Copper and copper alloys - Wire for general purposes.
BS EN 12167	Copper & copper alloys - Profile and bars for general use.
BS EN 12168	Copper and copper alloys - Hollow rod for free machining purposes.
BS EN 12209	Building hardware. Locks and latches. Mechanically operated locks, latches and locking plates. Requirements and test methods.
BS EN 12320	Padlocks and padlock fittings.
BS EN 12365	Gaskets and weather stripping.
BS EN 12476	Phosphate conversion coatings of metals. Method of specifying requirements.
BS EN 13724	Letter plates.
BS EN 15338 + AI	Hardware for furniture strength and durability of extension elements and their components.
BS EN 15570	Hardware for furniture strength and durability of hinges and their components.
BS EN 15706	Hardware for furniture strength and durability of slide fittings for sliding doors and roll fronts.
BS EN 15828	Hardware for furniture: strength and durability of hinges prorating on a horizontal axis.
BS EN 16014	Hardware for furniture: strength and durability of locking mechanism.
BS EN 61558-1+A1	Safety of power transformers, power supplies, reactors and similar products. Part 1 - General requirements and tests.
BS EN ISO 1456	Metallic and other inorganic coatings - Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium.
BS EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods.
BS EN ISO 2081	Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel.
BS EN ISO 2082	Metallic coatings. Electroplated coatings of cadmium with supplementary treatments on iron or steel.
BS EN ISO 2931	Anodizing of aluminium and its alloys. Assessment of quality of sealed anodic oxidation coatings by measurement of admittance.
BS ISO 3864-1 & 4	Graphical symbols. Safety colours and safety signs.
BS EN ISO 7010	Graphical symbols. Safety colours and safety signs. Registered safety signs.
BS EN ISO 9445-1	Continuously cold-rolled stainless steel - Tolerances on

	dimensions and form - Part 1: Narrow strip and cut lengths.
BS EN ISO 9445-2	Continuously cold-rolled stainless steel - Tolerances on dimensions and form - Part 2: Wide strip and plate/sheet.
PD CEN/TR 15349:2006	Hardware for furniture strength and durability of hinges and their components. Terms for extension elements and their components.
PD CEN/TR 15588:2007	Hardware for furniture strength and durability of hinges and their components. Terms for hinges and their components.
PD CEN/TR 15709:2008	Hardware for furniture strength and durability of hinges and their components. Terms for slide fittings for sliding doors and roll fronts.
PD CEN/TR 16015:2010	Hardware for furniture: Terms for locking mechanism.
BS 476	Fire tests on building materials and structure.
BS 1449-1.1/1.8/ 1.14	Steel plate, sheet and strip.
BS 3621	Thief resistant locks.
BS 5499-2,4,6 & 10	Safety signs, including fire safety signs.
BS 5839 Pt. 3	Fire detectors and automatic release mechanisms.
BS 6100-1	Building and civil engineering - Vocabulary - Part 1: General terms.
BS 6100-6	Building and civil engineering - Vocabulary - Part 6: Construction parts.
BS 6496	Powder organic coatings for application and stoving to aluminium alloy.
BS 8220	Guide for security of buildings against crime.

* Products manufactured to these standards should meet the requirements of CE marking and carry the mark where they are intended for use on fire/smoke and locked doors on escape routes.

Other National Standards:

AAMA 611-98	American Architectural Manufacturer Association Voluntary Specification for Anodized Architectural Aluminum
ANSI/BHMA A156.18-2006	American National Standard for Materials and Finishes
AS 1476-1974	Australian Standard Specification for metric wood screws

DOOR IRONMONGERY

Keys **14.13** A minimum of two keys for each lock shall be provided, each fitted with a stainless steel split ring and a 25 mm diameter x 1.5 mm thick plastic disc engraved with the number of the lock or room number in figures a minimum of 5 mm high.

14.13A* All keys to be nickel silver finish.

Materials **14.14** Materials as specified shall comply with the following standards:

Aluminium: Refer to in Clause 17.7.

Stainless Steel: Grade 316 (18/10/3 molybdenum bearing grade) referred to in Clause 17.9. Lower grades will not be accepted for accessories such as lock strike plates, rebate components, etc.

Brass: Plate, sheets, strips and circles: **BS EN 1652** No. CW 612N R420 or H120.

Profile, rod, hollow rod, wire and bars: **BS EN 12163, BS EN 12164, BS EN 12166, BS EN 12167** and **BS EN 12168** No. CW 614N R430 or H110.

Real Bronze**:** Solid cast bronze of suitable copper-tin alloy according to **BS EN 1412, BS EN 12163, BS EN 12164, BS EN 12166, BS EN 12167** and **BS EN 12168** or **ANSI/BHMA A156.18.**

The product shall not contain any heavy metals or their compounds as listed below:

(a) Arsenic
(b) Cadmium
(c) Lead
(d) Mercury

Finishes

14.15 Finishes as specified shall comply with the following standards:

Stainless Steel shall be to **BS EN 10095**.

Electroplated coatings of nickel and chromium shall be to **BS EN ISO 1456**.

Anodic oxidation coating on aluminium shall be to **AAMA 611-98.**

Electroplated coatings of cadmium and zinc on iron or steel shall be to **BS EN ISO 2081** and **BS EN ISO 2082.**

Phosphate treatment of iron and steel shall be to **BS EN 12476**.

Hinges and pivots

14.20 Hinges and pivots shall be to **BS EN 1935** of the appropriate class for the door size, weight and duty, with heavy-duty, maintenance free, concealed bearings.

14.21 Where door closers incorporating hold-open devices or a backcheck facility, hinges with a minimum Grade 12, 13 or 14 to **BS EN 1935** shall be used.

14.22 Hinges shall be stainless steel, all finished to match other hardware on the door face, including plating to match brass, bronze or other finishes, where required.

14.22A* All hinges shall be proprietary product of grade 316 satin stainless steel with non-magnetic stainless steel pins, stainless steel washer, stainless steel machine screws and square corners and shall be full mortise type unless otherwise specified with flush barrels. Hinges used with doors fitted with door closers shall not generate excessive frictional torque.

14.23 Hinges with nylon bearings shall not be permitted in fire-resisting door assemblies.

14.24 Hinges shall be countersunk drilled, fixed with matching screws and of the following types:

(a) For timber doors and frames:	Jig drilled, with staggered drilling pattern and 12 screw gauge (SG) x 32 mm wood screws
(b) For pressed steel doors and frames:	ANSI template drilled with M5 or M6 x 12.5 mm machine threaded screws
(c) For timber doors with steel frames:	Different drilling patterns for leaf and frame as appropriate to timber and metal substrate

14.25 Outward opening external and/or security doors shall be provided with hinges with integral security studs.

14.26 Unless otherwise specified, two hinges shall be provided per leaf up to 1800 mm high and one extra hinge for each additional 450 mm height (or part thereof).

14.27 Conductor hinges or concealed fixing, flexible metal cable loops shall be provided to transfer wiring for electromagnetic fire hold closers, solenoid locks and the like between frame and door leaf.

14.27A The centre hung top pivot hinge used for door installation shall comprise the top pivot hinge assembly fixed onto the door frame and the bottom strap fixed onto the top rim of door leaf. The retractable pin of the top pivot hinge assembly shall be inserted into the bottom strap with adequate depth in accordance with the manufacturer's requirements. Insertion depth indication marker of conspicuous colour shall be set up on the retractable pin of top pivot hinge during installation of door for ease of routine inspection in future.

Overhead door closers

14.28 Door closing devices shall be hydraulic controlled closing types, from matching suites, with a full range of optional functions, including adjustable power, adjustable backcheck, mechanical and electromagnetic stand open and delayed closing. Uncontrolled devices (e.g. spring hinges) are unacceptable, due to noise of operation and potential for damage to doors, frames, ironmongery, etc.

14.29 All door closing devices used on metal fire rated doors shall incorporate fire retardant fluid.

14.30 Overhead door closers shall be capable of being fitted on either hand of the door and shall close the door positively. Regulation of the closing and latching speed shall be undertaken by independent control valves.

14.31 Closers for fire rated doors shall be tested to and comply with **BS EN 1154** Category of Use 4, to close a door from up to 180 degrees. In accordance with the Door and Hardware Federation (DHF), Code of Practice “Hardware for Fire and Escape Doors” (Clause 3.3.1), Certified, Approved and CE Marked. No closer for use on a fire rated door shall be less than power Size 3.

14.32 All products to have been incorporated in successful fire tests and assessed to **BS 476-22** (30, 60 and 120 minutes) and **BS EN 1634** (30, 60 and 120 minutes).

14.33 In addition to the corrosion test requirements of **BS EN 1154**, which relate to performance only, the visual requirements for significant surfaces shall be identified according to **BS EN 1670** Clause 4.7 Grade 3 to **BS EN 1154** shall apply.

14.34 Overhead surface closers shall suit doors of either hand and have 50 mm maximum projection, plain, rectangular, solid bodies of aluminium, brass or stainless steel construction, with visible surfaces, including arms, finished identically to other items on the door and with no permanent visible markings (except as required by relevant standards).

14.35 Overhead surface closers, except to plant rooms and pipe ducts shall be equivalent to **BS EN 1154** Class 4-8-2/4-1-1-3, power adjustable for doors from 400 mm to 1100 mm wide and 40 kg to 80 kg mass, or equivalent grade to Table 14.1 for doors of greater width/mass. They shall incorporate adjustable, hydraulic backcheck.

14.36 Overhead surface closers to plant rooms and pipe ducts shall be equivalent to universal arm (push- or pull-to) type, to **BS EN 1154** Class 4-8-2/4-1-1-3, for doors up to 1100 mm wide and 80 kg mass or equivalent grades to Table 14.1 for doors of greater width/mass.

14.37 To avoid reductions in efficiency which may result when fixing surface mounted closers on the pull side of a door, test data for all closers specified with parallel (pull-to) or universal (push- or pull-to) arms shall be provided to show that the closer achieves the specified power classification(s) when mounted on the pull side of the door.

14.38 Where universal (push- or pull-to) arms are specified, the closers shall be fitted on the least visible face of the door.

14.39 Door mounted overhead concealed closers shall be equivalent to the **BS EN 1154** Class 4-8-2/4-1-1-2, adjustable for doors from 500 mm to 1100 mm wide and 40 kg to 80 kg mass, or equivalent grades to Table 14.1 for doors of greater width/mass. The minimum door thickness shall be 45 mm.

14.40 Transom mounted overhead concealed closers shall be to **BS EN 1154** Class 4-8-4-1-1-3, for doors from 850 mm to 1100 mm and 80 kg mass, or equivalent grades to Table 14.1 for doors of greater width/mass.

Floor springs

14.41 Floor mounted concealed closers shall be heavy duty, adjustable, hydraulic check types, with thermo-constant stabilising fluid. All floor springs shall be non-handed (i.e. they are reversible). Single action straps are to be Grade 316 stainless steel, double action straps shall be forged steel, both with full intumescent protection. Also refer to Clause 14.27A.

14.42 All floor springs for double swing doors, including plate glass assemblies, shall have micro-adjustable toe-in and positive centring, to ensure that leaves can be fully aligned in closed position.

14.43 Single and double action floor springs shall be hydraulic check spring mechanisms sealed into an oil or hydraulic fluid box complete with a loose protected steel box for fixing within a concrete floor, a detachable cover plate with waterproof seal. Adjustment within the box shall provide full horizontal movement for door alignment, final positioning and height adjustment. The position of the floor spring within the loose box shall be adjustable after installation. The non-adjustable bottom strap shall be designed to suit the type, size and weight of the door but shall not be less than 160 mm long with holes for four screws. The top centre for double action floor springs shall be adjustable. If specified, a hydraulic back check shall be incorporated effective for the opening angle of the floor spring.

14.44 On single action floor springs, the bottomand top centre shall be suitably offset to suit the frame details, projection of pull handles, adjoining wall layout and other aesthetic aspects.

14.45 Where floor springs are fitted to a fire rated door, the floor springs shall have been tested in conjunction with an appropriate fire rated door and passed the integral fire test in accordance with **BS 476-22** or **BS EN 1634**.

In the event that the springs are fitted to metal doors, the specification shall be the same except that a non-ferrous strap shall be provided to suit the profile of the bottom rail of the door and the top centre shall suit the top rail of the door.

14.46 Exposed parts shall be finished to the same standard as the rest of the ironmongery unless stated otherwise in contract requirements. The top plate shall be satin finish stainless steel, 18/10/3 quality unless stated otherwise in contract requirements.

14.47 Floor springs for main circulation routes, auditorium and other heavy use locations shall be equivalent to **BS EN 1154** Class 4-8-2/6-1-1-3, power adjustable for doors from 300 mm to 1400 mm wide and 20 kg to 120 kg mass, or equivalent grade to Table 14.1 for doors of greater width/mass. They shall incorporate adjustable, hydraulic or mechanical backcheck, built-in levelling device and complete with Grade 316 stainless steel covers.

14.48 Floor springs for other locations shall be equivalent to **BS EN 1154** Class 4-8-1/4-1-1-3, adjustable power for doors up to 1100 mm wide and 100 kg mass, or equivalent grades to Table 14.1 for doors of greater width/mass. They shall incorporate hydraulic or mechanical backcheck, built-in levelling device and complete with Grade 316 stainless steel covers.

TABLE 14.1
BS EN 1154

1	2	3	4	5	6	7	8	9
Door closer power size	Recommended door leaf width	Test door mass	Closing moment				Opening moment between 0° and 60°	Door closer efficiency between 0° and 4°
			between 0° and 4°		between 88° and 92°	any other angle of opening		

	‘	kg	Nm min.	Nm max.	Nm max.	Nm min.	Nm max.	% min.
1	<750	20	9	<13	3	2	26	50
2	850	40	13	<18	4	3	36	50
3	950	60	18	<26	6	4	47	55
4	1100	80	26	<37	9	6	62	60
5	1250	100	37	<54	12	8	83	65
6	1400	120	54	<87	18	11	134	65
7	1600	160	87	<140	29	18	215	65

NOTE 1: The door widths given are for standard installations. In the case of unusually high or heavy doors, windy or draughty conditions, or special installations, a larger power size of door closer should be used.

NOTE 2: The test door masses shown are only related to door closer power sizes for the purpose of the test procedure. These test door masses are not intended to indicate maximum values for actual use.

Electromagnetic fire-hold closers

14.50 Electromagnetic fire-hold closers shall be to **BS EN 1155** and of the same design, finish and standards as other closers. Surface type fire-hold closers and floor-mounted concealed type shall be equivalent to Class 3-5-4-1-1-3. They shall allow the door to:

(a) Hold open electro-magnetically when set and, on receipt of a signal from a central fire alarm or other device, automatically release and properly close.

(b) Close immediately if physically pushed to, if an integral fire officer test button is pressed, or if power fails.

14.51 Power sources for fire hold closers shall be Class II Safety Isolated Transformers to **BS EN 61558-1+A1**. If fire alarm systems do not incorporate clean contacts, transformers shall incorporate relay control interfaces.

14.51A* Electro-magnetic hold open door closers for fire rated doors shall be tested in accordance with the applicable standards to demonstrate compliance with the Code of Practice for Fire Safety in Buildings 2011 and shall be in compliant with HKFSD requirements.

Automatic door operators

14.52 Automatic door operators shall be approved, high quality devices to **BS 7036**, to suit the door construction, configuration, location and frequency of use and operate at 230/240 vAC 50 Hz. Finishes shall match other hardware on the door and units shall be frame mounted wherever possible, on the door face least susceptible to weather and/or tampering.

14.53 Operators for fire rated doors shall be of suitable types which will not compromise the fire resistance rating, linked to fire alarm systems to close automatically in case of fire.

14.54 Operators shall allow adjustment of opening and closing speed, hold open time, backcheck and power and allow manual override, in case of power failure.

Door selectors

14.55 Where one leaf of a pair of self-closing doors must close before the other, due to rebated styles, latch bolts, suitable matching selectors to **BS EN 1158** Class 3-5-*-1-1-3 (where “*” denotes the appropriate door mass from Table 14.1), of types which do not obstruct ironmongery or affect fire resistance ratings, shall be supplied. Use sprung-arm, under-frame fixing selectors for outward opening doors and gravity face fixing types for inward opening doors.

Locks

14.56 Mortice lock suites shall be to **BS EN 12209** with:

(a) Forends and strike plates and rebate components if for rebated meeting edges, of materials to match door furniture, with no exposed sharp edges or corners.

(b) Piercing for bolting through of single sided lever or knob furniture, if required.

(c) Facility for full reversal of handing, without opening the case.

(d) If to receive lever handles, special, heavy springing against progressive lever droop (levers with sprung roses or back plates are unacceptable due to potential for damage and corrosion).

(e) If to receive knob handles, soft springing, with two-way action and 100mm minimum backset.

14.57 Cylinders shall be easily removable when the door is open, without dismantling trim but non-removable when closed.

14.58 Heavy duty, modular, security locks shall be obtained from an approved reputable source with 60 mm minimum backset and 72 mm centres. Latch bolts shall be 11 mm (minimum) low friction type, and deadbolts shall have 20 mm (minimum) throw (except for privacy function lock) with griptight 8 mm followers for noise reduction, closing efficiency, security and improved durability.

14.59 Heavy duty, high security locks and electrical solenoid locks shall have equivalent of 19 mm (minimum) throw stainless steel, three part, low friction, guided latch bolts with anti-thrust devices and/or 25 mm (minimum) throw deadbolts with hardened steel rollers, as appropriate. They shall be certified by an approved security body and shall have been tested in conjunction with an appropriate fire rated door and passed the integral fire test in accordance with **BS 476-22** or **BS EN 1634**.

14.60 General duty locks shall have equivalent of 11 mm (minimum) plated brass latch bolts and 13 mm (minimum) plated brass deadbolts, with hardened steel rollers. WC cubicle locks shall be mortice type, with inside thumbturn and coin operated, outside emergency release. Emergency releases shall incorporate red/white outside indicators.

Security locks

14.61 Security locks shall be to **BS 3621**.

14.62 Security locks shall have minimum of five levers or, if pin or disc, mechanisms shall have a minimum of six pin or disc tumblers or more than one row of pins and rollers, such rows shall not be in the same plane.

14.63 Forends shall be of double thickness and each lock shall be capable of being fitted to fully rebated doors with 12.5 mm or 25 mm deep rebate by the addition of a rebating set.

14.64 Keys shall be registered in the name of the Government and duplicates only obtainable through the manufacturer. Prior to ordering, agree with the SO the method of ordering, supplying and fixing to ensure the maintenance of security. Master keying shall not be permitted.

14.65 Exposed parts shall be satin finish stainless steel 18/10/3 quality. Rebating set shall be nickel plated brass to match.

Mechanical locking cylinders and keying

14.66 Cylinders shall be to **BS EN 1303** to match door furniture (including coloured finishes).

14.67 Standard cylinder lengths shall suit doors up to 55 mm thick, when used with the specified roses or back plates, with other lengths available as required.

14.68 Lock cylinders shall be capable of achieving required master keying systems, with adequate provision for future expansion, without compromise to security and without the need to cut keys to depths at which they become susceptible to breakage.

14.69 General lock cylinders shall be of five-pin, integrated keyway types, with double paracentric keyways, mushroom drivers, triple grooved, anti-pick pins, hardened

anti-drill pins, off-centre cams and three keys per cylinder as standard to **BS EN 1303** Grade 3.

14.70 High security lock cylinders shall be equivalent of six-pin, double-locking types, offering practically infinite differs, with double paracentric keyways, mushroom drivers, triple grooved, anti-pick pins and multiple side pins, hardened anti-drill pins, off-centre cams and three keys per cylinder as standard to **BS EN 1303** Grade 5.

14.71 Padlocks shall be of appropriate grades to **BS EN 12320**, and capable of master and construction keying together with other locks.

14.72 Unless otherwise stated, locks and panic exit devices shall be keyed to a system of Grand Master, Master and Sub-Master suites without compromise to security standards and shall be construction keyed, with ten keys provided for site use. On completion, operation by a master key shall exclude all construction keys.

Mechanical digital lock

14.72A* Mechanical digital lock shall be provided with sash lock case, the latch bolt shall be operated by stainless steel keypad of full mechanical operation and integral lever handle at both sides. Euro-profile cylinder with turn shall be provided to operate the double throw dead bolt of 20mm.

The mechanical digital lock shall be heavy duty, with code combinations of up to 12 buttons and capable of escaping from inside lever regardless of the lock status, i.e. latch bolt and dead bolt shall be operated by inside lever at all times. Key cylinder shall be able to operate the latch bolt and dead bolt at the same time so that the door can be unlocked by individual keys and/or master key even without knowing the code.

Electrical locks

14.72B* Electrical Digital Locks shall comprise 12 or 24V DC electromagnetic lock with power supply, compatible with electronic weather and vandal resistant stainless steel keypad to IP54.

Electrical locks used in fire rated doors and doors on escape route and fireman's access shall be equipped with lever handle in compliance with BS EN 179 for emergency exit and shall be tested in accordance with the applicable standards to demonstrate compliance with the Code of Practice for Fire Safety in Buildings 2011 and shall be in compliant with HKFSD requirements.

Door furniture and plates

14.73 Lever assemblies shall be non-sprung, to **BS EN 1906** incorporating four heavy duty captive, maintenance free, self lubricating and corrosion resistant bearings. Roses shall be concealed bolt through fixings type.

14.74 Spindles for furniture shall be corrosion proofed, high tensile steel. Standard spindles shall suit 35 - 55 mm thick doors.

14.75 Where half sets of furniture are to operate locks, special spindles requiring no piercing of the opposite door face shall be used.

14.76 For pairs of dummy levers or knobs “Rigidisers” shall be provided. For single sided dummy levers or knobs “Rigidisers” and special spindles requiring no piercing of the opposite door face shall be provided. Face fixed, fix dead spindles are unacceptable, due to vulnerability to forcible damage.

14.77 Pull handles shall be supplied with bolt through fixings and seating cups, concealed by push plates on the reverse face, or back-to-back fixings as appropriate. Face fixed pulls are acceptable only if unavoidable.

14.78 Protection plates shall be minimum 3 mm thick if aluminium and 1.6 mm thick if stainless steel or brass, with edges softened and radiused corners, to prevent injury. Fix plates with suitable countersunk screws located 5 mm from edges, at each corner and equally spaced, at 225 mm maximum centres. Clearance from the edge of the door or door frame shall not be more than 4 mm.

14.79 Furniture for privacy locks shall incorporate inside thumbturn and coin operated, outside emergency release. In public areas, emergency releases shall incorporate red/white outside indicators.

Panic exit devices

14.80 Panic exit devices shall be provided en-suite to match the door hardware.

14.81 All panic exit devices shall comply with **BS EN 1125** with the activating bar horizontally across the inside face of the door operating when pushed anywhere along its effective length in the direction of the exit and/or moved in a downwards arc. Where panic exit devices have vertical shoots, they shall have an automatic catch holding the bolts in a withdrawn position when the doors are opened and automatically releasing the bolts on the closing of the door.

14.82 Horizontal bar operated panic exit devices to single leaf doors in front of house and area accessible to the public shall be easily reversible, low projection, touchbar type to **BS EN 1125** Grade 3-7-6-1-1-3-2-2-B, with secret "hold unlocked" facility and photo-luminescent "in bar" signage to **BS 5499-2, 4, 6 & 10** and/or **BS ISO 3864-1 & 4**. Standard units shall suit doors 800 - 1380 mm wide and up to 3000 mm high, with options for other sizes as required.

14.83 Horizontal bar operated panic exit devices to single leaf doors in service areas accessible only to maintenance staff may be standard projection, push bar type to **BS EN 1125** Grade 3-7-5-1-1-3-2-2-A.

14.84 Panic exit devices to pairs of doors shall not allow escape to be prevented by padlocking a chain around crossbars or other components.

14.85 In addition to the corrosion test requirements of **BS EN 1125**, which relate to performance only, the equivalent visual requirements for significant surfaces of **BS EN 1670**, Clause 5.7 Class 3 shall apply.

14.86 Panic exit devices shall accept an outside cylinder and/or lever or knob handle operators, local alarms, remote monitoring and/or motor operation as required.

14.86A* For doors to staircases or protected lobbies of the staircases, The electro-mechanical locking devices shall be tested to meet the relevant requirements of the Code of Practice for Fire Safety in Buildings 2011 and accepted by the Fire Services Department.

Bolts

14.87 Bolts shall be to **BS EN 12051** and of the following minimum classifications:

(a) Flush bolts: Class 3-4-0-1-1-3-3, comprising keep and easy clean floor socket in wet areas or dust-excluding floor socket in other areas. Bolts shall have a 9.5 mm (minimum) diameter and shall be suitable to secure the inactive leaf of locking pair of doors.

(b) Barrel, tower and mortice bolts: Class 3-4-0-1-1-3-3.

(c) Foot drop, square spring of garage door bolts and padlock bolts: Class 3-4-0-1-1-4-4.

14.88 Unless otherwise stated:

(a) Bottom bolts shall be 150 mm minimum long.

(b) Top bolts to doors up to 2000 mm high shall be 150 mm long. For taller doors, increase bolt length by 150 mm for each 150 mm of additional height, or part thereof. For very tall doors, automatic flush bolts may be substituted.

14.88A* Unless otherwise stated, flush bolts shall be manufactured in satin stainless steel.

14.89 Bolts shall be of a high quality, lever action, flush type, with dovetail returns to resist forcing and/or frame damage. Mount lever action flush bolts to door edges, wherever practical, for concealed fixing.

14.90 Bolts to duct doors shall be of a good quality and anodised aluminium, surface type. Where doors open outwards, top bolts shall be necked to allow proper fixing.

Door stops	**14.91**	Door stops for the protection of doors, ironmongery or surfaces shall be of concealed fixing types with robust holders matching other ironmongery on the door and rubber inserts, which are easily replaceable.
	14.91A*	Door stop shall be manufactured in satin stainless steel of grade 316 and completed with rubber buffer.
Sliding gear	**14.92**	Sliding gear shall be high quality, proprietary units of suitable type and capacity, to **BS EN 1527**.
	14.92A*	The gear shall be supplied in kit form and shall be suitable for doors weighing up to 55kg or otherwise specified. Kits contain top assembly comprising heavy duty track, hanger plates, ball cage and runner bar, 2 nylon top plates with integral buffer, wall mounted stops, nylon floor guide and bottom channel for mortising into groove in bottom of door.
Flush pulls	**14.93**	Flush pulls and sliding door locks shall be from the same suite as other architectural ironmongery.
	14.93A*	Pull handles shall be grade 316 satin stainless steel, bolt-through or back to back fixing type to suit the operational requirements of each room.
Sundries	**14.94**	Ironmongery sundries hardware shall suit the location and function and match architectural ironmongery in quality, design and finish.
Hat and coat hooks	**14.95**	Where hat and coat hooks are vulnerable to abuse, heavy-duty hooks independently certified to withstand 1000 N applied load without deformation with the fixings supplied, shall be used. In psychiatric or detention facilities, units which collapse if improperly used and can be subsequently reset, shall be used.
	14.95A*	Hat and coat hooks shall be manufactured in satin stainless steel of grade 316 and completed with rubber buffer.
Door guard	**14.96**	Door guard shall be of brass, alloy or other metallic construction, complete with No. 10 x 30 mm wood screws, properly anchored and capable to withstand substantial impact load when engaged. Finish shall match other ironmongery on the door.
Door viewer	**14.97**	Door viewers shall have viewing angle not less than 180°.
	14.97A*	Door viewer shall be grade 316 satin stainless steel, bolt-through or back to back fixing type to suit the operational requirements of each room.
Indicating sign plates	**14.98**	Indicating sign plates shall be as for push plates, but satin anodised aluminium plates shall not be less than 1.6 mm thick. Self-luminous exit signs to comply with **BS 5499- 2.**
	14.99	Fire safety signs, notices and graphic symbols shall be as for push plates, manufactured to the standards laid down in **BS ISO 3864-1**.

FURNITURE IRONMONGERY

Fittings to drawers and cupboards	**14.100**	Fittings to drawers, cupboards and other joinery fittings shall be of a quality to match the door hardware in a co-coordinated range.

(a) Hinges shall be stainless steel or chromium plated brass.

(b) Standard drawer locks shall be cast zinc with a brass, or chromium plated brass cap approximately 22 mm diameter with a four tumbler cylinder and a 4 mm thick brass bolt. Locks for cash drawers shall be fitted with a brass spring loaded bolt.

(c) Flush or surface bolts shall have a minimum of a 6 mm diameter shoot.

(d) Ball catches shall have a 9.5 mm diameter ball mounted in a face plate complete with matching striking plate.

(e) Magnetic door catches shall have a plastic casing with overall length not less than 45 mm.

(f) Flush pulls shall be 100 x 50 x 18 mm deep fixed with four countersunk screws.

(g) Drawer pulls shall be 7.5 mm diameter rod twice bent to form handle 100 x 25 mm overall length each leg fitted with 3 mm threaded rod one end drilled and tapped at least 15 mm into the leg and the other end fitted with two flat washers and a nut.

(h) Drawer slides shall be heavy-duty rust proofed enamelled steel, with nylon cages and steel bearings able to bear the required load at full extension and with positive closing action.

IRONMONGERY SUNDRY

Dowels for fixing door frames **14.107** Dowels shall be 16 mm diameter galvanised steel rod 75 mm long.

Fixing cramps **14.108** Fixing cramps for door frames, and the like fixed in brick or block walls shall be 30 mm x 3 mm galvanised steel flat 250 mm girth, turned up at one end and twice drilled to suit No. 12 gauge screws and flanged at the other end.

Fixing bolts **14.109** Unless otherwise specified, fixing bolts for door frames, and the like fixed to concrete shall be not less than 10 mm diameter proprietary expanding anchor bolts 120 mm long overall, with nut and washer.

Water bar **14.110** Water bar shall be galvanised steel, stainless steel, aluminium plate or brass flat bars as specified.

Curtain track **14.111** Curtain track shall be an approved proprietary brand complete with matching fittings of the same make, as follows:

(a) Rigid UPVC ‘T’ box section track with nylon slides.

(b) Regular of double duty enamelled steel ‘C’ section track with nylon runner.

(c) Regular of double duty enamelled steel ‘C’ section track complete with cord operation.

Curtain rail **14.112** Curtain rail shall be stainless steel heavy duty hollow tube with matching purpose-made end flanges, all to the dimensions specified.

Towel rail **14.113** Towel rail shall be stainless steel heavy duty hollow tube with matching purpose-made end flanges.

Drying rack **14.113A*** Drying rack shall be aluminium tubular frame, complete with nylon ropes, roll-out canvas cover and anti-corrosion stainless steel mounting brackets and fixed by stainless steel anchor bolts.

Timber connectors **14.114** Steel connectors for timber shall be galvanised, round, tooth-plate type to **BS EN 912**.

Screw **14.114A*** Fixing screws shall be stainless steel of correct diameter to suit holes in the ironmongery to be installed. They shall be countersunk, half round or round-headed as required and with Philips head if visible. On no account are chromium or brass plated screws to be used.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 15

STRUCTURAL STEEL WORK

SECTION 15
STRUCTURAL STEEL WORK

Mechanical properties and chemical composition **15.2** Unless specified otherwise, all structural steel shall be Grade S275JR or S355JR, hot-rolled or hot-finished structural steel complying with **BS EN 10025** or **BS EN 10210** respectively, except that hot-finished hollow sections shall be Grade S275J0H, S275J2H, S355J0H or S355J2H complying with **BS EN 10210-1**.

Dimensions and tolerances of hot-rolled or hot-finished sections and plates **15.3** Dimensions and tolerances shall comply with the standards shown in Table 15.1:

TABLE 15.1

Section	Dimensions	Tolerances
Universal Beams and Columns	**BS 4-1**	**BS EN 10034**
Joists	**BS 4-1**	**BS EN 10024**
Channels	**BS 4-1**	**BS EN 10279**
Angles	**BS EN 10056-1**	**BS EN 10056-2**
Split Tees	**BS 4-1**	**BS EN 10034**
Rolled Tees	**BS EN 10055**	**BS EN 10055**
Plates (reversing mill)	**-**	**BS EN 10029**
Plates (cut from coil)	**-**	**BS EN 10051**
Wide flats	**-**	**UNI EU 91**
Hollow Sections	**BS EN 10210-2**	

Cold-formed open sections and profiled steel sheets **15.4** Cold-formed open sections and profiled steel sheets shall comply with **BS 5950-7** or equivalent. Proprietary products may be used with prior approval of the SO.

Cold-formed hollow sections **15.5** The mechanical properties, chemical composition, dimensions and tolerances of cold-formed structural hollow sections shall comply with **BS EN 10219-1** and **BS EN 10219-2**.

Ordinary bolts, nuts and washers **15.6** Ordinary bolts, nuts and washers shall comply with the standards given in Table 15.2, unless specified otherwise:

TABLE 15.2

Grade	Bolt	Nut	Washer
4.6	**BS 4190**	**BS 4190** (Grade 4)	**BS 4320**(1)
8.8	**BS 4190**	**BS 4190** (Grade 8) (2)	**BS 4320**(1)
10.9	**BS 4190**	**BS 4190** (Grade 10) (3)	**BS 4320**(1)

(1) Black steel washers to section 2 of **BS 4320**, normal diameter series.
(2) Nuts for galvanized or sherardized 8.8 bolts should be grade 10 to **BS 4190**.
(3) Nuts for galvanized or sherardized 10.9 bolts should be grade 12 to **BS 4190**.

High strength friction grip bolts nuts and washers **15.7** High strength friction grip bolts and associated nuts and washers shall be to **BS EN 14399-1** to **BS EN 14399-8** and **BS EN 14399-10,** unless specified otherwise.

Drill anchor bolts **15.8** Unless specified otherwise, all drill anchor bolts for external environment shall be in Grade A4 stainless steel to **BS EN ISO 3506-1** to **BS EN ISO 3506-4**, and electroplated anchors and hot-dip galvanized anchors shall not be allowed.

Holding down bolts **15.9** Unless specified otherwise, holding down bolts and associated nuts and washers shall comply with Table 15.3:

TABLE 15.3

Grade	Bolt	Nut	Washer
4.6	**BS 7419**	**BS 4190** (Grade 4)	**BS 4320**(1)
8.8	**BS 7419**	**BS 4190** (Grade 8) (2)	**BS 4320**(1)
(1) Black steel washers to section 2 of **BS 4320**, normal diameter series. (2) Nuts for galvanized or sherardized 8.8 bolts should be grade 10 to **BS 4190**.			

Shear studs **15.10** Proprietary shear studs for composite construction shall be the headed type and shall be in accordance with **BS EN ISO 13918** with the following minimum properties after being formed:

(a) Yield strength of 350 MPa;

(b) Ultimate tensile strength of 450 MPa; and

(c) Elongation of 15% on a gauge length of $5.65\sqrt{A_o}$, where A_o is the original cross section area of the test specimen.

The minimum diameter and the minimum depth of the head of a headed stud shall be 1.5*d* and 0.4*d* respectively, where *d* is the nominal shank diameter of the stud.

Markings **15.14** Clearly mark all steelwork in an approved manner. Individual pieces shall be capable of positive identification at all stages of fabrication.

Materials for grouting of base plates and end plates **15.15** Unless specified otherwise, grout around foundation bolts, under column base plates and behind connection end plates shall be one of the following types:

(a) Fluid cement mortar not leaner than 1:1 cement to fine aggregate by volume and be mixed as thickly as possible consistent with fluidity. The minimum amount of water is to be added to provide a viscosity suitable for the voids to be filled without bleeding or segregation of the fresh grout mix; or

(b) An approved proprietary non-shrink polymer modified cementitious or resin based grout that does not contain high alumina cement.

Grout shall have at least the same grade strength as the surrounding concrete.

FIRE PROTECTION FOR STRUCTURAL STEEL

Generally **15.66** Fire protection system shall comply with the requirements of the **Code of Practice for Fire Safety in Buildings** including its latest amendments and revisions issued by the Buildings Department and shall provide the structural steelworks with the required Fire Resistance Rating (FRR) as specified in the Contract or as required by the **Code of Practice for Fire Safety in Buildings**. ~~In case that specified proprietary products are used, they shall still comply with the requirements in Clauses 15.66 to 15.72.~~

Fire protection system **15.67** When specified, provide fire protection to structural steel by one of the following materials or system:

(a) Sprayed mineral coating to **BS 8202-1**;

(b) Intumescent coating system to **BS EN 16623**; or

(c) Proprietary fire protection board.

~~The fire protection system including its construction shall have been tested and~~

~~assessed to the requirements of **BS 476-20** and **BS 476-21** as being capable of resisting the action of fire for the specified periods. The tests and assessment shall be carried out by an Accredited Laboratory, or one of the assessing organizations listed in **APP-118** issued by the Buildings Department. The assessment report shall be within its validity period.~~

~~Details of application of the materials such as surface preparation, application of primer and fixing details shall be strictly in accordance with the approved tests and assessment report; no deviation can be made except for specific situations where some minor variations may be necessary. Such minor variations must be tested or assessed against established standard fire testing that the construction elements and the structural members are capable of resisting the action of fire for the specified period. The assessment should be carried out and the assessment report prepared and endorsed by a HOKLAS accredited laboratory or other accredited laboratory which has mutual recognition agreements / arrangements with the HOKLAS.~~

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 16

CURTAIN WALLS

SECTION 16
CURTAIN WALLS

Generally **16.1** For details regarding glass and glazing materials, such as gaskets and setting blocks, refer to the relevant parts of Section 20 – Glazing.

The use of glass in curtain walls shall be to **Code of Practice for Structural Use of Glass** including its latest amendments and revisions issued by the Buildings Department, except otherwise stated.

Generally **16.11**

(a) Materials shall be structurally sound, able to withstand local pollutants and marine conditions, as well as relative humidity fluctuations as may be experienced in the vicinity of the project. In addition, the materials shall be free from defects and blemishes, and shall conform to the relevant specified standards.

(b) Proprietary items that are site fixed shall be delivered to site in the manufacturer's original packaging.

(c) Materials of common type shall be obtained from the same manufacturer.

(d) All materials or components shall be fully compatible with each other. Submit test certificates to prove compatibility of any materials or components as requested by the SO.

Steel **16.12**

(a) Stainless steel shall be to **BS EN 10048, BS EN 10095, BS EN ISO 9445-1, BS EN ISO 9445-2** grading not inferior to 304 S15 with minimum thickness of 1mm and with all exposed edges rolled round. Manufacturer's test certificates shall be provided with each consignment to the Site to show that the material has been tested and found to comply with the relevant requirements of **BS EN ISO 9445-1, BS EN ISO 9445-2.** Alternatively, stainless steel shall be to **BS EN 10088** of corresponding grading with properties not inferior to Grade 1.4301(304 S15).

(b) Structural steel shall be to Clauses 15.2 and 15.3, galvanized in accordance with Clause 15.63 and tested in accordance with Clause 15.17.

Aluminium **16.13**

(a) Aluminium and Aluminium alloy shall be to Clause 17.07.

(b) The following alloy and temper combinations are acceptable for extrusions subject to fabrication, finish and structural requirements: 6063-T5; 6063-T6; 6061-T6. Other alloys of the 6xxx series and other tempers may be submitted for approval. Nominal wall thickness of 3.0 mm or greater is acceptable for structural extrusions; wall thickness less than 3.0 mm may be acceptable and is subject to approval. Minimum nominal wall thickness for non-structural trim shall be 1.5 mm.

(c) The following alloy and temper combinations are acceptable for sheet and plate subject to fabrication, finish and structural requirements: 3003-Hl4; 5005-H14. Other alloys of the 3xxx, 5xxx and 6xxx series and other tempers may be submitted for approval. Provide 3.0 mm minimum nominal thickness.

16.13A* (a) All extruded aluminium sections used in the curtain wall in this project shall be from the same manufacturing plant. Extrusion alloy and temper shall satisfy minimum requirements for 6063-T5, 6063-T6, 6061-T6 or equivalent standards. Fluorocarbon paint finish to aluminium extrusions, aluminium panels, aluminium trim, aluminium sun shades or covers to

mullions etc. All exterior fluorocarbon paint finish shall be in 4 coats of minimum dry film thickness (ASTM D1400) of 66 microns.

(b) All exterior aluminium panel for the external fascia of the building shall be minimum 3.0mm thick solid aluminium panel designed to satisfy loading requirements specified herein. Claddings shall be custom fabricated with all sides returns completed for hanging of claddings on holding tracks. Sliding clamp and supporting brackets shall be completed with high impact plastic isolator to prevent movement noises of claddings.

(c) All extruded aluminum sections used in the curtain wall in this project shall be from the same manufacturing plant. Fluorocarbon paint finish to aluminum extrusions, aluminum panels, aluminum trim, aluminum sun shades or covers to mullions etc. shall be either "Duranar XL", "Kynar 500", "Hylar 5000" or other products having equivalent functions or performance. All exterior fluorocarbon paint finish shall be in minimum 4 coats of minimum dry film thickness (ASTM D1400) of 66 microns.

Glass **16.14** Refer to Clauses 20.2 and 20.18.

16.14A* (a) Vision panels shall be Insulated Glass Units (IGU) comprising of minimum 10mm clear heat-strengthened glass with low-E coating inside, air gap of appropriate thickness and laminated glass made of minimum 8mm clear heat-strengthened glass + 1.52mm thick PVB interlayer + 8mm clear heat-strengthened glass All glass units shall be fabricated with autoclaved edges on all four sides. All glass substrates shall be thoroughly cleaned and dried prior to the fabrication of units. Fixing of glazed panels to the aluminium extrusions shall not be support entirely by structural sealant. Application of low-e coating to any side(s) of the laminated glass panel shall not be permitted. The spandrel panels shall be made of either minimum 10mm thick heat-strengthened glass or proprietary aluminium cladding panels in fluorocarbon finish or a combination of the above to achieve an integrated and distinctive building façade with an professional image appropriate to the police training facilities.

(b) In locations with special aesthetic concern, such as the main entrance, low-iron glass and SGP interlayer (for laminated glass) are preferred; subject to the design concept and structural calculation.

(c) The glass panels used in glass wall, glass canopy and skylight shall be laminated glass made of minimum 8mm clear heat-strengthened tinted glass + 1.52mm thick PVB interlayer + 8mm clear heat-strengthened glass, with custom designed fritted pattern (allowing possibly at 2 surfaces of the laminated glass) and shall either be supported on spider clamps or held in position by structural sealant. In any case, glass shall not be entirely supported by structural sealant while support and/or glazing beads shall be minimized when viewed from outside. In locations with special aesthetic concern, such as the main entrance or any featured atrium with skylight etc, low-iron glass and SGP interlayer (for laminated glass) are preferred; in that case, glazing beads could possibly be removed to achieve a frameless design, subject to the design concept and structural calculation.

Stone **16.15** (a) The nominal thickness of the stone shall be determined by the specified tests and design rules but shall not be less than as specified. These tests must include for flexural strength test in accordance with **ASTM C880/C880M** and anchorage test in accordance with **ASTM C1354/C1354M**. Determination method for thickness should follow accepted methods (e.g. **CWCT** Recommendations).

(b) Actual stone thickness shall be nominal thickness plus/minus 2.0 mm.

(c) Stone shall be free of damage to front face, back face and edges.

(d) Stone type shall be as specified.

(e) Stone finish shall be as specified and within acceptable colour range.

Anchors in stone **16.16**

(a) Stone shall be supported by continuous kerf clips in sawn grooves at two opposite edges of each piece of stone as a minimum. Kerf clips shall be set in a continuous bed of neutral cure silicone sealant, which has been shown by specified test requirements not to stain the stone. Where the stone has exposed edges and kerf clips are therefore not suitable for use, other methods of anchorage will be permitted.

(b) Kerf clips shall be formed stainless steel or aluminium extrusions. Mill finish aluminium extrusions are not permitted. Extrusions should be anodized (5 μm minimum) or have a chromate conversion / alodine finish.

(c) Anchors in stone other than kerf clips for use in limited areas shall be considered if submitted. Such anchors shall be stainless steel and may be supplemented by an epoxy adhesive which must not restrict the thermal movement or result in any stresses being imparted to the stone other than those due to wind load. However, anchors which rely solely on adhesive shall not be acceptable, positive engagement of the restraint in the stone must be achieved. Alternate anchors shall be subject to approval.

(d) The following types of anchors shall not be acceptable:

(i) Wires.

(ii) Anchors whose only means of attachment to stone or building is a bed of grout, mortar or adhesive.

(iii) Anchors secured in a hole with lead wool packing.

(iv) Anchors which transfer load from one piece of stone to another, rather than to the building structure.

(e) Anchors in stone shall allow for differential thermal movement of stone and the support system.

(f) Adjustment slots in brackets with serrated grooves and matching serrated locking washers will be permitted but tests are required to demonstrate the capacity of the anchorage method is acceptable.

(g) Open ended slots in any stone anchorage brackets are not permitted.

Glazing materials **16.17** Refer to Clause 20.2.

Anchors in concrete and masonry **16.18**

(a) Anchors, including cast-in-situ anchor channels or other embedded fixings in concrete and masonry that are not manufactured from stainless steel shall be hot dip galvanized rolled steel, or hot dip galvanized cold formed steel to **BS EN ISO 1461**. Galvanize steel parts of anchors. ~~After field welding, remove weld slag and touch up affected area as specified in Clause 15.63.~~

(b) Strength of embedded anchors shall be developed by integral projections or by welded deformed bars or headed studs.

(c) At masonry, through bolts shall be acceptable provided that bearing plates are used at both masonry surfaces. Anchor bolts shall be acceptable only with prior approval from the SO.

(d) At concrete, all fixings including bolts should be cast-in-situ. Anchor bolts shall be acceptable only when prior approval has been obtained from the SO.

(e) Self drilling, self threading screws shall not be acceptable.

(f) Screw-in plugs and powder actuated fasteners shall not be acceptable.

(g) Where curtain wall anchors are installed in "wet area"/"area exposed to weather", anchors are upgraded to Stainless Steel Anchors embedded in concrete.

(h) Anchor bolts, anchor channels or other proprietary fixings shall be installed in accordance with manufacturers' specifications including bolt distance, edge distance and embedment depth.

Fastener **16.19**

(a) Fastener requirements listed below shall be applicable to screws, bolts, nuts, washers, rivets and pins.

(b) Stainless steel fasteners shall be to **BS EN ISO 3506-1** and **BS EN ISO 3506-2** on Mechanical properties for corrosion- resistant stainless steel fasteners. Fasteners outboard of or within a glazing pocket, gutter, flashed cavity or other potentially wet location (after completion of construction) shall be of grade preferably A4. Fasteners inboard of potentially wet locations shall be of grade not inferior to A2.

(c) Stainless steel washers shall comply with **BS 4320** and **BS 4464** as far as sizes and tolerances are concerned.

(d) Bolts, screws, nuts and washers shall be to Clauses 15.6, 15.7 and 15.39, as a minimum, galvanized to Clause 15.63 and tested to Clause 15.19.

(e) Provide lock washer or other locking device at all bolted connections.

(f) Powder actuated fasteners shall not be acceptable.

(g) Aluminium fasteners shall be to **BS 1473**.

(h) Actions subsequent to any failure of material or test specimens shall be in accordance with the requirements of Clause 15.21.

Shims **16.20**

(a) At connections subject to thermal movement or other movement, separate all pairs of moving surfaces with friction reducing pads. Pads shall be minimum 3 mm thick, sufficiently capable of reducing friction to permit movement and shall also reduce movement noise to a level acceptable to the SO, shall be resistant to wear and positively retained in position (open ended slots shall not be acceptable). Pads shall not be subjected to heat damage from welding or cutting or to excessive pressure from over-tightening of bolts.

(b) Shims which transfer shear forces (tending to slide one shim against another) shall be steel plates, set in a staggered pattern and fillet welded to each other and to the adjacent steel surfaces. The shims and welds shall be structurally designed to support the applied loads.

(c) Plastic shims shall be acceptable at static connections for which the shims transfer only compressive forces.

(d) Wood shims shall not be acceptable.

Weep hole filters **16.21** Weep hole filters shall be 8 to 18 pores per centimeter reticulated PVC coated cell urethane foam, compressed by 30% to 50%.

Sealants **16.22** (a) Capping sealant shall be a one part gun grade neutral curing silicone elastomeric sealant meeting the performance requirements stated below:

Capping Sealant Properties	**Testing Method**	**Performance Requirement**
Shore A Hardness	**ASTM C661**	15-30
Tensile Strength	**ASTM D412**	0.69 MPa min. (100 psi)
Ultimate Elongation	**ASTM D412**	350% min.
Movement Capacity	**ASTM C719**	± 50%
Elasticity Modulus	**ASTM D412**	0.3 MPa min. (45 psi)
Peel Strength	**ASTM C794**	3.5 kN/m min. (20 lb/in)
Accelerated Aging	**ASTM C793**	250 hrs min. UV exposure time without cracks
Ozone/Ultraviolet Resistance	Weatherometer	Excellent
Staining	**ASTM C510**	None

The colour of the sealant shall be as selected / approved by the SO.

(b) The preferred caulking sealant shall be a one part gun grade neutral curing silicone elastomeric sealant meeting the performance requirements stated below:

Caulking Sealant Properties	**Testing Method**	**Performance Requirement**
Shore A Hardness	**ASTM C661**	15-30
Compression Set	**ASTM D395** Method A	
Tensile Strength	**ASTM D412**	0.69 MPa min. (100 psi)
Ultimate Elongation	**ASTM D412**	
Movement Capacity	**ASTM C719**	± 50%
Elasticity Modulus	**ASTM D412**	

Peel Strength	**ASTM C794**	
Accelerated Aging	**ASTM C793**	250 hrs min. UV exposure time without cracks
Ozone/Ultraviolet Resistance	Weatherometer	Pass
Staining	**ASTM C510**	Pass

If modified polyurethane sealant is used, properties must be submitted for approval prior to the placement of the order.

(c) Structural sealant shall be either:

(i) One part gun grade neutral moisture curing silicone elastomeric sealant or

(ii) Two part structural silicone elastomeric sealant. Products requiring mixing of components shall be acceptable only for shop application with mixing and application equipment acceptable to the sealant manufacturer.

(d) The structural sealant shall meet the performance requirements stated below:

Structural Sealant Properties	**Testing Method**	**Performance Requirement**
Shore A Hardness	**ASTM C661**	25-50 as in **ASTM C1184-05**
Tensile Strength	**ASTM C1184**	0.83 MPa min. (120 psi)
Ultimate Elongation	**ASTM C1184**	100% min.
Movement Capacity	**ASTM C719**	± 25%
Elasticity Modulus	**ASTM C1184**	0.3 MPa min. (45 psi)
Peel Strength	**ASTM C794**	4 kN/m min. (20 lb/in)
Accelerated Aging	**ASTM C1184**	pass 5000 hrs weathering test
Ozone/Ultraviolet Resistance	Weatherometer	Excellent
Staining	**ASTM C510**	Pass

(e) Comply with printed instructions and recommendations of the sealant manufacturer regarding joint size limitations, mixing, priming, and application. Unless printed instructions advise to the contrary, do not apply sealants when substrates are wet or when the temperature is below 4ºC.

(f) Sealant back-up materials shall be polyethylene foam, urethane foam or extruded silicone as recommended by sealant manufacturer.

(g) All sealant shall be tooled as a separate operation after application.

(h) Coordinate with other sections to assure compatibility of intersecting sealants.

16.22A* (a) Sealant materials proposed if required for use shall be as BS 6262:1982. Sealant backing shall be of the closed-cell butyl, neoprene or polyethylene sponge rubber roe type, compatible with sealant as recommended by sealant manufacturer.

(b) Sealants shall not be used as weather or waterproofing barrier, unless otherwise stated.

(c) The colour of silicone sealant shall be black, unless otherwise stated. The Contractor shall state the period during which the silicone sealant will not change in appearance or colour. Any discoloration of silicone sealant during this time shall not be acceptable.

(d) Excess silicone sealant shall be removed and all joints shall be neat and clean.

(e) Silicone sealant joints shall be adequately protected during the curing process to avoid contamination by dust and other debris.

Thermal insulation and fire-safing insulation

16.23 The maximum Overall Thermal Transfer Values (OTTV) to be used in the design of the building envelope shall be as designated in the Particular Specification but is required to be more energy efficient than the requirements of **APP-67**. The ArchSD requirement for the OTTV should be referred to the Department Operational Instruction.

(a) Insulate spandrel glass and other non-vision areas with thermal insulation having a 50 mm minimum thickness and a 0.127 mm thick reinforced aluminium foil vapour barrier. Insulation is to be installed on the interior side of the backpan. Maintain a suitable air space between glass and the back pan. U value is to conform to the overall OTTV requirements of the building as specified in the Particular Specification. Care must be taken to ensure that a double vapour barrier is not caused by the use of any foil sealing tape.

(b) Insulation shall be mechanically retained by aluminium or galvanized steel clips or straps, or integral pockets within the window frames. Maximum spacing of clips and straps shall be 600 mm. Welded or glued impaling pins at 300 mm centres shall also be acceptable. Maintain a suitable air space between glass and the back pan.

(c) Support insulation where it contacts fire-safing, to prevent bow of insulation from pressure exerted by fire-safing.

(d) Completely fill void at floor and roof edges with fireproof material, thickness as required to provide a 2-hour fire rating. The fire barrier must also prevent the passage of smoke. If fire-safing material is used it must be foil backed and smoke seal used at all junctions on the upper face.

(e) Fire-safing is to be compressed 20% to 30%. Support fire-safing insulation on galvanized steel support clips spaced at a maximum of 450 mm centres if the installed fire-safing width is in excess of 150 mm. Alternatively a full width galvanized mild steel tray can also be used to support the fire-safing.

16.23A* Thermal insulation shall be installed so as to prevent the formation of condensation within the spandrel cavity. The contractor shall submit dew point calculation and

diagrams. The mineral wool insulation material shall have a UL rated flame spread less than 15, density of 8 pounds per cubic foot, and a melt point in excess of 2,000F. Insulation shall be located on the interior side of the aluminium back pans and shall be positively retained by welded impaling pins, aluminium clips, aluminium straps, galvanized steel sheets or straps or integral pockets within the window.

Operable windows **16.24**

Operable windows shall be required to conform to the requirements of this Specification. Except as otherwise specified herein, operating windows shall also conform (as a minimum) to **App-37**, **App-116**, **BS 4873, BS 6375-1+A1, BS 6375-2 and BS 6375-3+A1**:

(a) Weather-strips, glazing gaskets and glazing blocks shall be extruded silicone, EPDM or neoprene. Provide gaskets on both sides of the vent glass unless it is structurally glazed.

(b) The required test specimen size is the maximum size operable window for this project.

(c) Locks and strikes shall be white bronze or type 304 or 316 stainless steel, although suitably finished aluminium extruded keepers and strikes will be acceptable if part of a proven multi-point lock set. Provide a minimum of two locks and two strikes per vent.

(d) Fixed frames and vent frames shall be extruded aluminium with an acceptable factory applied finish. Vent frames shall consist of a tubular profile.

(e) Weather-strips shall have a continuous spline engaged in a continuous groove in the aluminium sash and/or fixed frame. Two continuous lines of weather-strip shall be required at vent perimeters, except for the designed apertures in the external gasket to allow pressure equalization of the interstitial cavity.

(f) If an integral pivot is not used, balance arms shall be provided and these shall be four-bar 300 series stainless steel type 304 or 316 with adjustable friction shoe. Provide two balance arms per vent.

(g) Provide two limit stops per operable window. Material shall be 300 series stainless steel type 304 or 316. Stops shall restrict clear opening to 100 mm. Effective ventilating area shall be based on the maximum clear opening, not on the gross window area.

(h) Operable windows are to have removable handles or special keys to enable the windows to be opened.

(i) Hinges and fastening mechanisms shall withstand positive and negative pressures due to specified wind conditions when the windows are in the open or closed positions.

Composite and honeycomb panels **16.25**

(a) Honeycomb Panels

(i) Honeycomb panels shall have a construction method with a minimum in-use history of 15 years and shall have a nominal overall thickness of 25.0 mm

(ii) Face and back sheets shall generally be aluminium with nominal thickness of 1.0 mm. Alloy shall be of the 3xxx, 5xxx or 6xxx series and shall satisfy structural and finish requirements. Provide formed edge returns and seal edges with silicone sealant. Bonding surfaces shall be chemically pretreated to assure effective and durable bond. Other facing materials may also be suitable and will only be permitted if approved prior to use.

(iii) Core shall be hexagonal cell aluminium foil with minimum nominal thickness of 0.0762 mm. Cell size shall not exceed 6.0 mm measured across flats. Foil shall have an organic corrosion resistant coating. Alloy shall be 3003, 5052, or 2024.

(iv) Adhesive shall be a thermal setting modified epoxy with a minimum set temperature of 121ºC. The adhesive shall form a fillet at the perimeter of each cell, and shall continuously bond each cell to the face and back sheets.

(v) For panels in place, deviation from flatness of exterior face shall not exceed 2 mm along any straight line which extends from a panel edge to any other edge. Where the edge is concealed, the nearest exposed point to the edge shall be used.

(vi) Panel exterior face shall be free of visual discontinuities such as ripples, creases, dents, bubbles and blisters, regardless of the measured deviation from flatness at such discontinuities.

(b) Composite Panels

(i) Composite panels shall have a construction method with a minimum in-use history of 15 years and shall have a minimum overall nominal thickness of 4.0 mm.

(ii) Face and back sheets shall generally be aluminium with equal thickness of 0.5 mm. Alloy shall be of the 3xxx, 5xxx or 6xxx series and shall satisfy structural and finish requirement.

(iii) Core shall be entirely of non-combustible materials which meet the requirements of **BS 476-4** or **BS EN 13501-1** Class A1.

(iv) Edges requiring Vee-cutting to enable folding to occur shall be cut in accordance with the manufacturer's requirements. Failure to do so may result in rejection of the material.

(v) Provide formed edge returns with a residual core thickness of 0.2 to 0.4 mm and seal edges with reinforcements and silicone sealant.

(vi) Structural support must be provided by means other than the return edge.

(vii) Bonding surfaces shall be chemically pre-treated to assure effective and durable bond.

(viii) Other facing materials may also be suitable and will only be permitted if approved prior to use.

Louvres **16.26** (a) Louvres shall consist of extruded or roll formed aluminium perimeter frames and blades. Frame corners and blade ends shall be welded or fastened with 300 series stainless steel screws. Provide concealed extruded aluminium stiffeners for blades, such that vector sum of blade deflections

parallel to blade principal axes does not exceed 1/175 times span at design pressure. Assume that pressure acts perpendicular to the plane formed by the corners of the perimeter frame, and that the tributary area for one blade equals its projected area on the same plane.

(b) Louvres in external walls are to comply with the water resistance requirements of **ANSI/AMCA Standard 500-L**. Coordinate free area of louvres with mechanical requirements.

(c) Inactive louvres shall be closed by aluminium sheet with minimum 3.0 mm nominal thickness, fastened and sealed to the indoor louvre surfaces. External face of sheet is to be finished with an approved factory applied architectural finish.

16.26A* Louvres shall be proprietary aluminium continuous louvre system finished with min. 3 coats of PVF2 coating to match the colour, texture and appearance of the other aluminium panels to match the façade design.

Copings **16.27** Copings shall comply with the following:

(a) Copings shall comprise of aluminium, minimum 3.0 mm thick or stainless steel, minimum 2.0 mm thick. Unless specified to the contrary in the Particular Specification, the surface finish shall be the same type of finish and colour as the visible external framing.

(b) Copings shall be rigid, reinforced with a metal frame if required and shall be fixed rigidly to the structure. Copings shall be strong enough to resist forces due to typhoon and casual impact.

(c) Ends of coping panels and joints to curtain wall frame shall be tightly sealed up and an effective drainage system shall be provided to drain out any water that may penetrate through the joints.

Concealed and exposed flashing **16.28**

(a) Acceptable elastomeric materials are silicone, neoprene or EPDM sheet. If rigid sheets are used, stainless steel sheet and aluminium sheet with a chromate conversion/alodine or a minimum 5 μm anodized finish are acceptable. Minimum thicknesses are 1.6 mm for PVC and neoprene, 0.25 mm for stainless steel, and 1.0 mm for aluminium. Aluminium shall be required to have a bituminous or other type of separation coating against dissimilar metallic materials.

(b) Provide sealed lap joints, end dams and transitions to gutters, dressings to roofs/abutments, louvres and screens to A/C intakes and exhausts.

(c) PVC, EPDM, Silicone or neoprene sheet shall not be acceptable as primary gutters, which shall be metal with suitable corrosion protection.

(d) Exposed flashing shall be strong enough to resist forces due to typhoon and casual impact.

FINISHES

Generally **16.30** Exposed metal surfaces shall be finished to match the appearance, colour and texture of the samples as approved by the SO.

Finishes to metals shall be as specified in Section 17 and the Particular Specification, complying with the requirements stated below shall be the minimum:

(a) Clear or coloured anodic finish to aluminium shall comply with the relevant clauses of **BS 3987, BS ISO 10074** and **BS EN 12373**.

(b) No. 8 bright polished finish to exposed faces of stainless steel.

(c) No. 7 polished finish to stainless steel or chromium plated ironmongery.

(d) Alternative finishes shall be approved by the SO.

(e) Organic coatings shall meet the requirements of **AAMA 2604** for internal and **AAMA 2605** for external finishes.

(f) All as specified and indicated on the drawings.

Protective treatments **16.31** Protective treatment to concealed steel parts of the curtain wall system such as fixings, connectors, etc., shall be hot dip galvanizing to **BS EN ISO 1461**.

All welding and provision of holes shall be completed before galvanizing.

No in-situ welding is allowed unless prior approval has been obtained from the SO. Details of the protective treatment to damaged galvanizing caused by the welding must be submitted to the SO prior to any welding being carried out.

Anodic coating to aluminium and testing of same **16.32** The thickness of anodic coating shall be a minimum of 25 µm for external use and 15 µm for internal usage.

Concealed surfaces are to have a 10 µm minimum thickness. Coloured anodic coatings and testing of same shall be as approved by the SO.

Anodic coatings are required to be sealed using a hydrothermal process, or cold impregnation/cold sealed based on nickel fluoride immersion process to achieve a finish in accordance with **AAMA 611**.

Six sets of colour range samples for both sheets and extrusions (with at least 2 samples each) are to be provided which show the limits of both colour and patina of the anodic coating. These are to be submitted for approval prior to the commencement of production.

Samples of finished aluminium from production lots shall be tested in accordance with **AAMA 611** and **BS EN 12373** and the requirements of the European Qualanod Quality Organisation.

Complete sets of finish process records and certified inspection records for quality of finish shall be maintained and made available to the SO on request. The client or his representative will have the right to audit and inspect any manufacturer without prior notice.

Repair of damage to finished surfaces by mechanical means (other than those specified) or by painting is strictly forbidden unless authorized in writing by the SO.

Surfaces prior to finish shall be free from mechanical imperfections such as scratches, scrapes and dents. Finished surfaces shall be free from finished imperfections such as spots, stains and streaks.

Anodized aluminium shall comply with **AAMA 611** and remain free from visible chalking, crazing and surface corrosion (when viewed from a distance of 3 m) for the duration of the warranty period.

Materials may be finished more than once provided that all specified requirements are satisfied. However, any material which has been finished twice and is still not acceptable shall be rejected.

Organic coating finish to aluminium

16.33 Organic coating finish shall comply with the following general requirements:

Also refer to Section 17 ~~of this GS.~~

(a) Dry film thickness of coating on all the exposed surfaces, or on hidden surfaces if required, shall not be less than the minimum requirements of the paint manufacturer. Paint all visible and exposed surfaces of metal cladding. Surfaces that are not exposed to view must have a protective coating that, if not the same as the visible surfaces, must be approved by the SO.

Prepare and submit colour samples to the SO. After selection by the SO, prepare 6 sets each of two samples which shall define the colour and gloss range and submit to the SO for endorsement. Samples shall be identified and attached with a full laboratory report as required by **BS 4842, BS EN 12206-1** and the requirements of the relevant **AAMA** specification if applicable.

Painted aluminium PVDF finish shall be a factory applied oven cured minimum two-coat finish of a fluoropolymer resin supplied by a licensed formulator with a minimum of 70% Kynar 500 / Hylar 5000 solids. The licensed formulator shall confirm that the finish which is supplied meets the minimal requirements for formulation as set forth in the licensing agreement. Painted aluminium powder coat finish shall be a factory applied oven cured system of a single coat that complies with the performance requirements of **AAMA 2604** as a minimum.

Application of the finish shall be carried out in accordance with the specifications issued by the licensed formulator and by an applicator specifically approved by one (or more) of the formulators. Test panels must be painted during the production process and tested to ensure adhesion, coating thickness and all other significant properties are in accordance with the manufacturer's requirements. Evidence of these test samples may be required to be submitted prior to final acceptance of the finish. The applicator shall provide written notification of approval by a formulator prior to application of the finish. The formulation shall contain at least 70% Kynar 500 / Hylar 5000 fluoropolymer resin in the residual solids.

Pre-treat metal surfaces in accordance with the procedure recommended by the manufacturer to provide proper surfaces for coating. In the absence of any recommendations from the manufacturer. For all exterior powder coating and painting, etching is required to a depth equivalent to 2 g/m^2 of substrate removal. Interior coatings require etching to a depth of 1 g/m^2. Where possible "Chrome Free" chromate conversion should be carried out in accordance with a procedure that is acceptable to the organic coating supplier.

16.33A* (a) Generally, the curtain wall shall be designed as a fully unitised system incorporating the rainscreen principle resulting in pressure equalized system. Aluminium framing shall be finished with 4 coat metallic fluorocarbon finished to **AAMA2605-02** or equivalent for all exposed surfaces both inside and outside of the building.

(b) All extruded aluminium sections used in aluminium cladding system in this project shall be from the same manufacturing plant. All exterior fluorocarbon paint finish shall be in minimum 4 coats of minimum dry film thickness (**ASTM D1400**) of 66 microns.

Aluminium finish at structural silicone

16.34 (a) Mill finish shall not be acceptable at structural silicone bonding surfaces.

(b) Aluminium surface to which structural silicone will be adhered shall have a finish which demonstrates by test the ability to satisfy specified requirements. Subject to testing, acceptable finishes shall be as follows:

(i) Factory applied single coat powder polyester or a minimum two-coat oven cured fluoropolymer paint conforming to **AAMA 2605** for external usage.

(ii) 25 µm anodizing conforming to **AAMA 611**.

(iii) Alodine conversion coating.

Glass Fiber Reinforced (GRC Panel) Cladding System

16.87*

(a) Constituent materials

The GRC components shall consist of a mixture of Portland cement, sand, water, alkaline-resistant glass fibres, polymer and pigment. Admixtures may be used per the design requirements.

(b) Water:-

Water shall be clean and free from deleterious matter that may interfere with the colour, setting or strength of concrete. It shall comply with BS 3148:1980.

(c) Cement:-

Cement shall be Ordinary Portland cement to BS EN 196:1995 "Specification for Ordinary and Rapid Hardening Portland Cement" and shall be obtained from a single source throughout the process of manufacture for the whole Project. The supplier shall provide test certificates showing the results of cement strength tests.

Fibre Cement Board Cladding System

16.88*

(a) Physical Properties

Density	1500kg/m3 Min.
Thermal Conductivity	0.5W/mK Min.
Structural Performances:	Achieve a safety factor of no less than 3 on flexural strength and 5 for anchorage design (The minimum thickness of cladding to be used in this project shall be 12mm)
Fire Resistance (BS476)	Non combustible (Part 4)
Durability Clarification (BS12467)	Category A
Strength Classification (BS 12467)	Class 4 or above
Water Absorption (BS EN 12467)	Pass
Soak Dry Test (BS EN 12467)	Pass
Impact Resistance (BS 8200)	Category B for wall. No fallen particle shall be allowed for soffit or ceiling applications

(b) Fibre Cement Board shall be mounted on a support framework of either grade 316 stainless steel or aluminium while the supporting bracket shall be fixed by proprietary grade 316 stainless steel under-cut anchor.

(c) Tolerances shall refer to Tolerance (BS EN 12467:2004 clause 5.3)

Anti-drumming backing

16.89*

Those panels installed at the ground level up to 2500mm high, shall have the backing of 9mm thick calcium silicate matrix reinforced fibre board. It shall be glued with "3M" Scotch Grip Contact Adhesives No. 1357 to the back of the specified metal cladding and column cladding panels. The adhesives shall resist heat and continuous load stress and meets MIL-A-21366A and MMM-A-121.

Stone Sealers	**16.90***	Treat all surfaces of stone (both exposed and concealed surfaces) with 4 coats of stone sealer system and apply to the manufacturer's direction before installation.
BIPV	**16.91***	Integrated fixing system for BIPV shall be allowed in the curtain wall and cladding system designs; All housing for wiring works associated with the BIPV; Concealed cable path leading from the BIPV to an internal area in the building; Care should be taken in positioning of the BIPV in order not to cause glare to resident in nearby high rise residential building blocks; Glass used for the fabrication of BIPV shall either be heat strengthened glass or tempered glass in compliance with Section 20 of General Specification for Building 2012. Both the BIPV glass panels together with fixing system shall be designed to withstand the relevant wind load requirement.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 17

METALWORK

SECTION 17
METALWORK

Steel **17.1** Steelwork shall comply with requirements stated in this Section unless specified otherwise in the Drawings or steelwork requiring the design to be certified by a Registered Structural Engineer shall comply with Section 15.

Hot-rolled or hot-finished steel shall comply with **BS EN 10025** or **BS EN 10210** respectively.

~~Cold-formed open section and profiled steel sheets shall comply with **BS 5950-7** or equivalent. Cold-formed hollow sections shall comply with **BS EN 10219-1** and **BS EN 10219-2**.~~

~~Bolts and nuts shall comply with **BS 4190**, and washers shall comply with **BS 4320**. Holding down bolts shall comply with **BS 7419**.~~

Valid manufacturer's certificates which include mill certificates shall be provided for all steelwork materials delivered to the Site.

17.1A* The use of mild steel shall only be permitted where the component is readily accessible for regular inspection and maintenance.

Cold-formed open section and profiled steel sheets shall comply with **BS 5950-7** or equivalent. Cold-formed hollow sections shall comply with **BS EN 10219-1** and **BS EN 10219-2**. Cold formed pre-galvanised steel sections shall comply **BS EN 10142, BS EN 10143, BS EN 10147**.

Bolts and nuts shall comply with **BS 3692, BS 4190, BS EN 24032, BS EN 24033, BS EN 24034**, and washers shall comply with **BS 4320**. All plain and tapered washers shall comply **BS 4320**, Form E. Holding down bolts shall comply with **BS 7419**.

Galvanized steel sheet and coil **17.2** Hot dipped galvanized plain steel sheet and coil shall be to **BS EN 10143**.

Steel mesh **17.3** Welded wire mesh shall be steel wire of the specified diameter welded to form a square or oblong mesh as specified and shall be hot dip galvanized after manufacture as specified.

Expanded steel mesh shall be to **BS 405.**

For expanded metal lathing in plasterinfg and rendering, see Section 18.

For expanded metal mesh or lathing in brickwork or blockwork, see Section 9.

Steel tubing **17.4** Steel tubing shall be to **BS EN 10255** "medium" grade and galvanized.

Slotted steel angle **17.5** Slotted steel angle shall be self-finished angle. Fittings to be stainless steel.

Cast iron **17.6** Cast iron shall be grey cast iron to **BS EN 1561** Grade 150.

Aluminium alloy **17.7** Aluminium alloy plate; sheet and strip shall be to **BS EN 485-1+A1, BS EN 485-2, BS EN 485-3, BS EN 485-4, BS EN 515, BS EN 573-1, BS EN 573-2, BS EN 573-3, BS EN 573-5** of required alloy designation.

Aluminium alloy bars, extruded tube sections and hollow sections shall be to **BS EN 515**, **BS EN 573-1, BS EN 573-2, BS EN 573-3, BS EN 573-5, BS EN 755, BS EN 12020,** alloy designation 6063.

Aluminium alloy sections for structural purposes shall be to **BS 1161**.

Aluminium alloy drawn tubes shall be to **BS EN 515, BS EN 573-2, BS EN 573-3, BS EN 573-5** and **BS EN 754** alloy designation 6063.

17.7A* Aluminium sheet thickness shall be not less than 3mm. Sheet alloy and temper shall satisfy the following minimum requirements :

(i) for painted finishes 3003-H14 or 5005-H34

(ii) for anodized finishes 5005-H34

(iii) All sheet products shall be stretcher leveled flat.

Aluminium framing members and trims shall be **BS 8118**, extruded aluminium grade 6063 T5 or similar

Aluminium reinforcing sections, where permitted, be incorporated within the aluminium extrusions to provide additional stiffness or strength shall be in conformance with **BS 4 and BS 5950**. Consideration shall be given to the prevention of bimetallic corrosion.

All extruded aluminium shall be the manufactured product of one company.

All sections shall be formed true to detail and free from defects, impairing appearance, strength or durability.

Brass rods and sections **17.8** Brass rods and sections shall be to **BS EN 12163, BS EN 12164, BS EN 12167** designation CW 106C condition M.

Stainless steel **17.9** Stainless steel plate, sheet and strip shall be of grade 316 or 304 to **BS EN 10088-2** for flat product, **BS EN 10088-3** for long product; **BS EN 10095; BS EN 10048; BS EN ISO 9445-1; BS EN ISO 9445-2,** of Finish No. DP1 for dull polish or "satin" finish, No. 2R for smooth, bright and reflective finish, No. 2B for mill finish, No. 1G or 2G for polish and low-reflective finish with fine grit and No. 1P or 2P for bright reflective mirror polished finish with a high degree of image clarity, or otherwise as required. Where the surface finish is specified as micron (RA), a certificate shall be submitted for the SO's verification.

Where welding is required, the steel shall be grade 316S13 or 304S11.

Stainless steel tubes for structural and general engineering purposes shall be to **BS EN 10296-2**, composition and finish shall be as above.

Stainless steel fasteners to follow steel grade of members shall be connected and to **BS EN 10263-1, BS EN 10263-5**.

Stainless steel anchors and inserts shall be of grade 316S31, A4 to **BS EN ISO 3506**.

Each consignment of the stainless steel material delivered to the Site shall be accompanied with test certificates or reports regarding the compliance of grading, issued by an accredited laboratory.

17.9A* Minimum thickness of stainless steel at covers and trims shall be 1.5mm with all exposed edges rolled round.

Fixings generally **17.10** Fixings generally shall be of the same material and finish as the material to be fixed.

Unless specified otherwise, all drill anchor bolts for external environment shall be in Grade A4 stainless steel to **BS EN ISO 3506-1** to **BS EN ISO 3506-4**, and electroplated anchors and -dip galvanized anchors shall not be allowed.

Unless specified otherwise, grout under base plate and end plates shall be either (i)

fluid cement mortar not leaner than 1:1 cement to fine aggregate by volume and be mixed as thickly as possible consistent with fluidity; or (ii) approved proprietary non-shrink polymer modified cementitious or resin based grout. Grout shall have at least the same grade strength as the surrounding concrete.

17.10A* All fixing brackets shall be stainless steel grade 304 (internal), 316 (exposed) or aluminium grade 6061-T6. Finish exposed fasteners to match adjacent aluminium. Exposed fasteners may only be used when approved. The work shall be designed to conceal all fasteners. No drilled fixing shall be allowed in any structural hollow members.

Rivets shall not be allowed for structural application.

Inserts in the building structure shall be either stainless steel grade 304 or galvanized steel minimum grade 250.

Steel fasteners with cadmium and coloured chromate plated shall be **ASTM B696**, Class #5, Type II finish 5mm thick. All non-stainless fasteners being used in a structural application must meet the minimum requirements of **SAE J429** Grade 5. Grade 8.2 fasteners, high strength bolts that are zinc plated shall not be used. Welding of high-grade fasteners is prohibited.

Stainless steel grade 304 screws and bolts shall be cold worked to A2-50 minimum.

Stainless steel grade 316 screws and bolts for external application shall be cold worked to **BS 6105** A4-50 minimum. All bolted connections shall use matched material and grade of nuts, bolts and washers.

Washers shall either be aluminium grade 6061-T5 or T6 or stainless-steel grade 304.

All fixings shall be designed such that there will be no risk of working loose due to the effects of cyclic effects of load, deflections and thermal expansion. This shall be achieved by the use of locking nuts, locking washers or application of an accepted locking fluid or wire ties.

The use of self tapping and self drilling screws as structural fasteners shall be limited to proprietary products with recognized supporting experimental data. When non-proprietary products are to be used, the performance of the fastening systems are to be tested.

The use of welded aluminium studs on cladding panels shall undertake the same testing procedures as the self-tapping and self-drilling screws above.

Metal insert channels for concrete

17.11 Concrete insert channel shall be an approved galvanised steel channel, with expanded polystyrene temporary filler. Provide matching sliding fixing devices.

Adhesive for metal

17.12 The application of adhesive for bonding metal to metal shall be according to the manufacture's recommendations, and the specimen tests shall be conducted to ASTM standards. Tensile test can refer to **ASTM D897**. Peel or stripping strength to **ASTM D903**. Impact strength of adhesive bonds to **ASTM D950**. The material shall be accompanied with test certificates or reports, issued by an accredited laboratory.

The following requirements shall be complied with:

(a) VOC content limits on regulated adhesives stipulated in the Air Pollution Control (VOC) Regulation of Hong Kong.

(b) Shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1- trichloroethane and carbon tetrachloride).

(c) Shall contain no more than 0.01% by wet weight of formaldehyde.

(d) Shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

Welding generally **17.16** ~~Remove grease, dirt, moisture, oxide and scale from the edges to be welded.~~

~~Ensure accuracy, using clamps or jigs where practicable. Use tack welds for temporary attachment where jigs are not practicable.~~

~~Joints shall be fully fused throughout with no holes, pores or cracks.~~

~~Prevent weld splutter falling on self-finished surfaces visible in the completed work.~~

~~Butt welds, visible in completed work, shall be ground smooth and flush and fillet welds to be ground smooth, if required. For continuous butt welds and fillet welds of exposed architectural steelworks, mock-up samples of the welded joints with ground smooth surface shall be submitted to the SO for approval.~~

~~Ensure complete removal of flux residue and slag.~~

~~Welding of steelwork shall be by metal arc process in accordance with **BS EN 1011-1** or other method subject to the SO's approval. Welder shall be tested to meet the requirements of **BS EN 287-1** or approved equivalent standards.~~

Welding consumables for steelwork shall be to **BS EN ISO 2560**, **BS EN ISO 14341**, **BS EN ISO 14171** or **BS EN ISO 17632** as appropriate and strictly in accordance with the manufacturer's recommendation. Choose welding consumables to ensure that the mechanical properties of the weld metal are not less than those required for the parent metal.

Finishing to steel **17.21** Finishes to steel shall be as follows:

(a) Bare to receive painted finish.

(b) Electroplated coating of zinc shall be to **BS EN ISO 2081**, Class A, 0.025 mm thick.

(c) Zinc sprayed coating shall be to **BS EN ISO 2063** - nominal thickness 0.2 mm unless otherwise specified.

(d) Galvanising shall be hot-dip galvanising to **BS EN ISO 1461**. Components shall be galvanised after fabrication, if required. The name and location of the galvanizing factory shall be submitted to the SO for approval. Provide the valid galvanizing factory's certificate showing that the galvanized coatings comply with the requirements including the test results carried out for thickness of coating.

No zinc sprayed coated or hot-dip galvanised items shall be welded or drilled and any subsequent cutting is defined as damage which shall be subsequently made good after coating or galvanising.

Make good damage to zinc coatings and galvanising, treat cut ends of galvanised sections with two coats of metallic zinc-rich priming paint to **BS 4652**.

17.21A* Finishes to mild steelwork shall depend upon the location of the finished element as follows:

(a) External to vapour barrier, visible and accessible for maintenance - galvanized and painted

(b) External to vapour barrier and inaccessible for maintenance – galvanized (and painted if visible)

(c) Internal to vapour barrier, cladding brackets – galvanized

(d) Internal to vapour barrier – painted

Mild steel components shall be hot-dip galvanized after forming and drilling in accordance with **BS EN 1461**. The cutting, drilling or working of galvanized components shall not be permitted.

Cut ends or surfaces working to pre-galvanized sheet steel or any damage to galvanizing (hot-dipped or otherwise) shall be repaired with zinc rich paint complying with **BS4652**.

Finishes to aluminium **17.22** Finishes to aluminium alloy shall be as follows:

(a) Mill.

(b) Polished.

(c) Polished and treated with a protective lacquer.

(d) Clear anodised shall be to **AAMA 611** and of the thickness grade and surface texture as follows:

(i) Interior work Class 15 (minimum average thickness of 15 μm).

(ii) Exterior work Class 25 (minimum average thickness of 25 μm).

(iii) Internal concealed surface Class 10 (minimum average thickness of 10 μm).

(e) Colour anodised shall be to **AAMA 611** average 25 μm thick.

(f) Approved proprietary hardcoat anodic finish with better wearing qualities than standard anodising of the required thickness.

Chromium plating **17.23** Chromium plating shall be to **BS EN ISO 1456,** for "service condition No. 3", with "bright", "dull" or "satin" finish.

Chromium plating to window components shall not be formulated with the following substances or their compounds:

(i) Arsenic
(ii) Cadmium
(iii) Hexavalent chromium
(iv) Lead
(v) Mercury
(vi) Organic tin
(vii) Phthalates

Galvanized steel tubing **17.27** Carefully notch, fit and weld galvanized steel tubing to produce accurate joints which shall be ground smooth and treated with two coats of zinc rich priming paint to **BS 4652**.

METAL WINDOWS AND DOORS

Steel windows and doors **17.32** Steel windows and doors shall be obtained from an approved manufacturer and constructed to **BS 6510** and in accordance with the following:

(a) When fixed in position, windows and doors shall be designed to withstand a wind load calculated in accordance with the **Code of Practice on Wind Effects in Hong Kong** with a minimum pressure of 3 kPa and a permissible

maximum deflection of 1/180 of the length of the member under consideration. Calculations shall be required to be submitted for approval.

(b) Frames shall be square and flat with mitred, welded corners and with glazing bars machine tenoned and/or welded to frames.

(c) Water bars shall be welded to the frames for the complete width of the windows or doors.

(d) When weather bars are specified, weld same to the frames for the complete width of the windows or doors.

(e) Provide all slotted adjustable lugs and screws necessary for building in the windows and doors and ensure that lugs project 60 mm (minimum) beyond the metal frames.

(f) Provide loose mullions and transoms of total length to suit window or door openings together with additional 75 mm at each end for building in.

(g) Provide sufficient mastic and bolts for assembly of all composite units and assemble same at the Site, including bedding mullions and transoms in mastic with all interstices completely filled.

(h) Windows and doors shall be suitable for external glazing unless otherwise specified. Provide rolled steel heavy channel section glazing beads size as specified for windows and doors, mitred at corners and fixed with galvanized mild steel flat headed countersunk screws at 225 mm centres (maximum) and tap frames to receive screws.

(i) All members shall be hot-dip galvanized or zinc sprayed as specified in Clause 17.21.

(j) When specified, provide an approved chloroprene rubber or polyvinyl chloride weatherstrip securely fixed into the dovetail groove in the section to provide a continuous contact between the opening casement and the fixed frame.

(k) Window and door fittings and furniture shall be approved and as follows:

(i) Steel hinges with brass pins and welded or riveted to frames. Projecting hinges to side-hung casements where windows shall be cleaned from the inside.

(ii) All fittings including friction grip pivots, casement fasteners, spring catches, brackets, slide arms, shoes, slip bolts, cabin hooks and eyes and handles, all of manganese brass with bronze finish. All to retain the opening parts rigidly in both the open and closed positions.

(iii) Handle plates, round headed stay brackets welded to the fixed frames with interchangeable handles and stays.

(l) Windows and doors shall be hung to open as indicated and fitted with the following fittings and furniture:

(i) Side-hung casement and vertically centre-hung ventilator - a two-point nose fastener or a two throw casement fastener with mild steel adjustable connecting rod and a 250 mm peg stay or bronze sliding stay, as specified.

(ii) Projecting casement - bronze sliding shoes, pivots and friction side arms and one spring catch with ring for hand or pole operation and two square-shank barrel bolts.

(iii) Top-hung ventilator - 200 mm peg stay with round-headed stay bracket welded to the fixed frame and with a second peg to secure the stay firmly and horizontally against the first peg when the ventilator is closed.

(iv) Bottom-hung ventilator - a spring catch and fanlight roller stay to limit opening and to permit the ventilator to swing free for cleaning.

(v) Horizontally centre-hung ventilator with a spring catch, with ring and eye for cord or pole operation.

(vi) Doors - sliding bolts of suitable length, striking plates at top and bottom, cabin hooks and eyes of suitable length, three-lever mortice lock with two keys, lever handles and escutcheon plates, as specified.

(m) When specified, provide extruded aluminium flyscreens having plastic covered fibre-glass mosquito gauze with 7 x 7 mesh per 10 mm^2.

Where flyscreens are provided, side hung casements shall have a locking handle and an opening and closing mechanism consisting of a bronze cam handle and bronze roto operator, and top hung casements to have bronze "through-the-frame" type stays.

(n) When specified, high openable windows in inaccessible locations shall be fitted with either electrical or manual remote control gear.

(o) Provide temporary steel clamps at the top and bottom of all opening lights of casements prior to transportation from factory till fixed in position.

(p) Paint surfaces: as specified in Section 21. Metal windows and doors shall be delivered to site unprimed.

Steel Door **17.32A*** Steel doors shall be provided with or without glazed viewing panels and to be in hairline/satin Grade 316 stainless steel finish both sides unless otherwise specified. Door frames shall be in matching stainless steel finish and from the same door manufacturer.

Aluminium windows and doors **17.33** Aluminium windows and doors shall be obtained from an approved manufacturer and constructed in accordance with the following:

(a) When fixed in position, windows and doors shall be designed to withstand a wind load calculated in accordance with the **Code of Practice on Wind Effects in Hong Kong** with a minimum pressure of 3 kPa and a permissible maximum deflection of 1/180 of the length of the member under consideration. Where necessary use galvanized steel cores, anchors, brackets, etc. as stiffeners. Calculations shall be required to be submitted for approval. Cores, anchors and brackets etc. shall be finished to Clause 17.33(p).

(b) Sections shall be extruded aluminium alloy to **BS EN 485-1+A1, BS EN 485-2, BS EN 485-3, BS EN 485-4, BS EN 515, BS EN 573-1, BS EN 573-2, BS EN 573-3, BS EN 573-5** and **BS EN 755, BS EN 12020,** British alloy designation 6063 with a minimum wall thickness of 2.0 mm and dovetail grooved for weatherstrip.

(c) Aluminium coating shall be as follows:

(i) Refer to Clause 16.32 for anodic coating.

(ii) Refer to Clause 16.33 for organic coating.

(d) Frames shall be mechanically jointed of mortice and tenon construction to provide rigid and secure connections. Mechanically joint and mitre sash members to develop the full strength of members using solid block angle pieces and provide a neat weather-tight joint. Provide adequate drainage in bottom members.

(e) Provide galvanized steel fixing lug spaces at 300 mm centres (maximum) for outer frames of each unit. Where specified, fix lugs with rag-bolts or approved proprietary stud anchors fixing bolts.

(f) Provide water bars of galvanized steel or other approved material for the complete width of the windows or doors where the design of the window requires.

(g) Assemble all composite units at the Site, including provision of all necessary bolts, screws etc. and sealing all joints with an approved sealant.

(h) Unless otherwise specified, provide an approved chloroprene rubber, polyvinyl chloride or nylon pile weatherstrip securely fixed into the dovetailed groove in the window or door sections to provide a continuous contact between each opening part and its fixed frame.

(i) Windows and doors shall be suitable for internal glazing unless otherwise specified. Provide an approved glazing system and aluminium beads. Securely clip beads to the frame or use beads which shall be an integral part of the frame.

(j) Use aluminium alloy, stainless steel or nylon for all exposed fixings including screws, nuts, bolts, washers and rivets and match up with finish where possible. Use stainless steel or galvanized steel for all concealed fastening devices.

(k) Window and Door fittings and furniture shall be approved and as follows:

(i) Friction pivots and sliding stays - stainless steel. To provide a maximum opening of 100° and a minimum clearance of 100 mm between frame and window for cleaning purposes.

(ii) Casement fasteners, locking handles, spring catches, casement stays, brackets, slip bolts and the like:

(1) Diecast zinc alloy to **BS EN 1774** suitably coloured to match the anodised window or door metal.

(2) Moulded stainless steel with satin finish.

(iii) Locks stainless steel or brass shoots etc.

(iv) Pull handles anodized aluminium.

(v) Rollers, guides etc. stainless steel or brass rollers to suit weight of door or window. To be adjustable after installation.

(l) Remote control gear shall be hand operated shaft and lever or conduit and cable remote control system with bronze or diecast zinc alloy bevel gear boxes, adjustable arms and keyed shafts.

~~(m) Windows and doors shall be hung to open as indicated and fitted with the following fittings and furniture:~~

~~(i) Side and top hung windows - Friction pivots and sliding stays and casement fastener (dual if necessary) or pull handle and locking handle (dual if necessary).~~

~~Top hung windows in inaccessible locations shall be fitted with remote control gear.~~

~~(ii) Sliding windows - Rollers, guides etc., pull handle and stops, sliding bolts or locking mechanism. The window should be designed so that it cannot be lifted off its rollers without the removal of a safety device.~~

~~(iii) Side hung doors - Floor springs and adjustable top pivots, single or double action to stand open or not as specified, mortice dead lock, top and bottom flush lever bolts and push plates and pull handles as required.~~

~~(iv) Sliding doors - Heavy duty rollers, guides etc., pull handle and stops, hook bolt locking latch and four bolts.~~

(n) When flyscreens are specified, they shall be located on the inside. The frames shall be extruded aluminium with plastic covered mosquito gauze of 7 x 7 mesh per 10 mm^2. Screens shall be fixed to window frames by turn buckles. The windows shall be fitted with locking handles and an opening and closing mechanism comprising cam handles and roto operator.

(o) Prime with zinc chromate primer and paint two coats of bituminous paint on all steel framework, cores, anchors and brackets.

(p) Paint one coat of bituminous paint on concealed aluminium or stainless steel surfaces which may come into contact with wet mortar, cement, plaster or similar materials.

(q) Apply a strippable coating or masking tape to all exposed aluminium or stainless steel surfaces. (NOTE: The anodised surface may be permanently damaged by contact with wet cement and plaster) Wrap all window and door units and other associated materials in stout waterproof paper or polythene to protect against damp and scratching and do not make premature delivery to the Site.

(r) Return to site on completion of building work, carefully remove protective coating and leave clean.

17.33A* (a) All windows shall be manufactured from fluorocarbon coated aluminium (both inside and outside) extruded sections. All extruded aluminium sections used in the Contract shall be from the same manufacturing plant. All aluminium extrusions, aluminium panels, aluminium trim, aluminium sunshades or covers to mullions etc. shall be finished with 4 coats of metallic fluorocarbon finish to **AAMA 2605-02** or equivalent for all exposed surfaces on both inside and outside of the building envelope.

(b) Windows and doors shall be hung to open as indicated and fitted with the following fittings and furniture:

(i) Side and top hung windows - Friction pivots and sliding stays and casement fastener (dual if necessary) or pull handle and locking handle (dual if necessary).

Top hung windows in inaccessible locations shall be fitted with remote control gear.

(ii) Sliding windows - Rollers, guides etc., pull handle and stops, sliding bolts or locking mechanism. The window should be designed so that it cannot be lifted off its rollers without the removal of a safety device.

(iii) Side hung doors - Floor springs and adjustable top pivots, single or

double action to stand open or not as specified, mortice dead lock, top and bottom flush lever bolts and push plates and pull handles as required.

(iv) Sliding doors - Heavy duty rollers, guides etc., pull handle and stops, hook bolt locking latch and four bolts.

(v) Openable aluminium windows shall be top hung, awning type or side hung, provided with multi-point locking system. Unless otherwise specified, openable windows shall conform to, as a minimum, **ANSI/ AAMA 101-88**, classification P-AW90.

(vi) Fixed frames and vent frames shall be extruded aluminium in the same type and finish as the systems under this Particular Specification. Vent extrusions shall include a tube for stability and shall not be interrupted by a thermal break.

(vii) Provide vent frame with two (2) continuous lines of dense neoprene weather-stripping. Weather-strips shall have a continuous spline engaged in a continuous aluminium groove. Comers of weather-strips shall be molded or permanently factory jointed and sealed.

(viii) Locks and strikes shall be non-magnetic stainless steel unless specified otherwise, Provide samples to the Supervising Officer for approval. Locks shall be concealed multi-point locking type with special keys for restricted use. Concealed locking device shall be constructed entirely of non-ferrous material. This locking device shall be concealed beneath the vent sash framing and only accessible by special handle (finished with PVF2) through a hole drilled in the vent sill member. When not in use, this access hole shall be plugged with a device capable of locking to prevent unauthorized usage.

(ix) Balance arms shall be non-magnetic stainless steel with adjustable friction shoe. At least two balance arms shall be provided per vent.

(x) Unless specified otherwise, openable windows shall have two limit devices per unit to restrict clear opening beyond 100mm. Material shall be non-magnetic stainless steel. Locks and strikes shall be 18-8, non-magnetic stainless steel unless noted otherwise. Provide one (1) pair of limiting stays and one (1) set of multi-point locking system with special keys for restricted use for each operable window. Devices shall be designed to allow for complete opening of ventilator if disengaged by use of special tool.

(xi) All operable windows shall be provided with engraved metal tags for fixing permanently to the sashes in warning against opening the sashes during typhoon signals and tropical monsoon signals.

(c) The façade systems shall sustain the above loads and movements whilst achieving the following serviceability limits:

Deflection

(i) Out of pane span/240 for steel framing members.

(ii) Out of plane span/180 for aluminium framing members or 20mm, whichever is less.

(iii) Span/90 or 25mm, whichever is less for DGU.

(iv) Span/60 or 25mm, whichever is less for monolithic glass units.

(v) Span/120 for metal panels.

Note : The "span" as noted above is the short dimension of the element in question, with reference to the plane of fixing to structure.

Fixing metal windows and doors **17.36** ~~When fixing metal windows and doors:~~

~~(a) Avoid distortion during handling and storage.~~

~~(b) Ensure tightness and clearance between sash and frame of all opening lights which shall be fixed until glazed.~~

~~(c) Avoid having construction access through window openings and/or placing scaffolding, boards etc. directly onto the window frames. If window openings must be used, then window frames at that opening location shall not be fixed until completion of the related internal works and the through route is no longer required.~~

(d) Assemble composite units including the provision of all necessary bolts screws etc. and seal joints with an approved one pack gun type polysulphide sealant to BS **EN ISO 11600+A1**.

~~(e) Position, plumb, level and square.~~

~~(f) Form pockets in heads, jambs, cills etc. to receive fixing lugs, build in lugs and made good and screw to frames or plug and screw frames using packing pieces where necessary. Do not distort frames when tightening fixings.~~

~~(g) Bed steel frames with water proof mortar, leaving no gaps. Mortar shall be an approved ready mix mortar or consist of 1 part of cement to 3 parts of sand together with the minimum amount of water necessary to achieve a consistency suitable for completely filling the gap between the frame and the opening. The mixture shall contain an approved proprietary water proofing and non shrink admixture.~~

~~(h) Bed aluminium frames with water proof mortar, leaving no gaps. Mortar shall be an approved ready mix mortar or consist of 1 part of cement to 3 parts of sand together with the minimum amount of water necessary to achieve a consistency suitable for completely filling the gap between the frame and the opening. The mixture shall contain an approved proprietary water proofing and non shrink admixture.~~

~~(i) Rake out the joints around external edge of steel window and door frames to the approval of the SO and point with an approved oil based mastic sealant to form a smooth, flat joint. Remove excess sealant from adjoining surfaces and leave clean. Mask adjoining surfaces which would be impossible to clean if smeared with sealant.~~

(j) Rake out the joints around external edge of aluminium window and door frames to the approval of the SO and point with an approved one-pack gun type polysulphide sealant to **BS EN ISO 11600+A1**, sealant to form smooth, flat joint. Remove excess sealant from adjoining surfaces and leave clean. Mask adjoining surfaces which would be impossible to clean if smeared with sealant.

~~(k) Avoid contact with concrete, mortar, plaster, or similar materials.~~

External metal door **17.36A*** External metal doors shall meet following requirements:

(a) All stainless-steel doors facing external areas, shall be constructed of min. 1.2mm thick hairline/satin finished stainless steel (grade 316) over similar finished stainless-steel frame of adequate width and height to suit the functional and maintenance requirements.

The doors shall include ventilation louvers and fire dampers (as appropriate), locking device, self-closing device and other ironmongeries, stainless steel angle door frame (of grade 316), local buzzer and door contact connected/linked back to the security office/rooms/booths and control room for security monitoring. External ventilation louvers of weather-proof type shall be provided with wire mesh of s.w.g. 24 and aperture not larger than 6mm.

(b) Doors shall be weather-tight and constructed to withstand severe weather conditions. Unless approved otherwise by the Supervising Officer, all doors exposed to weather shall be protected by R.C. canopies (finished/covered with external 3mm thick aluminium cladding with flashing in 4 coats fluorocarbon finish) projecting at least 500mm from the face of the external wall.

(c) Doors shall be seamless or continuously welded with at least 3 nos. heavy-duty stainless-steel security hinges per door leaf, with door and door frame reinforced as necessary.

(d) Fixing of frames shall be secure by lock in anchor system or similar, to be approved by the Supervising Officer.

(e) All ironmongery and locking devices including push plates and pull handles shall be of matching stainless steel or matching finish. The backset of cylinder lock sets shall be 95mm and completed with master key systems.

(f) All doors and frames (including fire doors) shall be in accordance with the relevant standards, with appropriate certification. All fire rated metal doors shall be tested in accordance with the standards stipulated in the **Code of Practice for Fire Safety in Buildings** issued by the Buildings Department, or assessed against such standards based on relevant test reports. The Contractor shall ensure that the test and assessment reports are prepared in accordance with Clauses E l 6.1 and E l 6.2 of the **Code of Practice for Fire Safety in Buildings**.

(g) The fire rated doors shall be successfully tested with or without a latching mechanism in **BS 476-22** or **BS EN 1634-1** fire test and **BS EN 1634-3** smoke test. A test certificate issued by a HOKLAS accredited laboratory or other laboratory accreditation bodies which have reached mutual recognition agreements/ arrangement with HOKLAS certifying the required fire resisting rating of the door assemblies shall be submitted to the Supervising Officer for acceptance. Supply ironmongery templates and responsible for: -

(i) Ensuring correct operation and validity of fire ratings.

(ii) Ensuring that their sections, details and reinforcement are suitable for the proposed ironmongery.

(h) All hardware shall be stainless steel unless otherwise specified and shall include, but not be limited to, the following:

(i) Floor or overhead concealed offset closers with selective hold open.

(ii) Door checks.

(iii) Stainless steel offset pivots.

(iv) Thumb turns.

(v) Custom satin finished stainless steel push/pulls.

(vi) Custom aluminium thresholds with Class I clear anodized finish.

(vii) Structural multi-point locks.

(viii) Security lock.

Stainless steel doors **17.36B*** Stainless steel doors facing external areas shall meet following requirements:

(a) Quality Assurance

(i) Provide steel doors and frames complying with the Steel Door Institute recommended specifications for Standard Steel Doors and Frames **ANSI/SDI 100**.

(ii) Steel doors and frames shall be manufactured to high quality standards in manufacturing facilities with annual certified conformance to **ISO 9001**.

(b) Reference

(iii) Steel doors and frames in this section shall meet all standards as established by the following listing.

(iv) Door and Hardware Preparation **ANSI 115**.

(v) Fire Doors to **BS 476-22**

(vi) Steel Door Institute **ANSFSDI-l 00**

(c) Hardware locations and general reinforcements

(i) Locate hardware on doors and frames in accordance with the manufacturer's standard location.

(ii) Hardware reinforcements are to be in accordance with the minimum standard gages as listed in **SDL 100**.

(iii) Doors shall be mortised, reinforced and function holes provided at the factory in accordance with the hardware schedule and templates provided by the hardware supplier. Through bolt holes, attachment holes, or drilling and tapping for surface hardware, shall be done by others in the field.

(d) Door material and construction

(i) Sheets shall be made of 1.2 mm thick stainless-steel grade 316.

(ii) Mechanically interlocked, hemmed vertical edge seams for added strength and rigidity.

(iii) Hinge reinforcement to be not less than 7 gage (3/16") plate 1-1/4" x 9". Approved equal is a 12 gauge continuous channel with formed holes drilled and tapped. The manufacturer is to provide test information with submittal that this type reinforcement is equal to a 3/16" or 7 gage plate reinforcement.

(iv) Reinforce tops and bottoms of all doors with a continuous steel channel not less than 16 gage, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel shall have a steel closure channel screwed or welded in place so the web of the channel is flush with the top of the face sheets of the door. Plastic fillers are NOT acceptable.

(v) Door cores shall be solid mineral fibre core.

(e) Frame material and construction

(i) Materials - Sheets are to be made of 1.5mm thick stainless steel grade 316.

(ii) Frames shall be mortised, reinforced, drilled and tapped at the factory for template mortised hardware only, in accordance with approved hardware schedule and template provided by the hardware contractor. Where surface mounted hardware is to be applied, frames shall have reinforcing plates only; all drilling and tapping to be done in the field by others.

(iii) Hinge reinforcements to be 7 gauge stainless steel.

(iv) Dust boxes/mortar guards to be no less than 26 gauge.

(f) Performance and test

(i) **ANSI A 250.4** - Physical Endurance Test with 1 ,000,000 cycle

(ii) **ASTM E330-84**, Structural Performance test with result 110 psf

(iii) **ASTM E 90-90**, Sound Transmission test with 33 STC rating

Galvanized steel doors **17.36C*** Galvanized steel doors shall be provided with or without glazed polycarbonate viewing panels as required and to be in powder coated finish both sides in accordance with the General Specification for Building. Door frames shall be in matching powder coated finish and from the same door manufacturer.

(a) Quality Assurance

(i) Provide steel doors and frames complying with the Steel Door Institute (SDI) recommended specifications for Standard Steel Doors and Frames **ANSI/SDI 100**.

(ii) Steel doors and frames shall be manufactured to high quality standards in manufacturing facilities with annual certified conformance to **ISO 9001**.

(b) Reference

Steel doors and frames in this section shall meet all standards as established by the following listing.

(i) Door and Hardware Preparation **ANSI 115**

(ii) Fire Doors to **BS 476-22**

(iii) Steel Door Institute **ANSI/SDI-100**

(c) Hardware locations and general reinforcements

(i) Locate hardware on doors and frames in accordance with the manufacturer's standard location.

(ii) Hardware reinforcements are to be in accordance with the minimum standard gages as listed in **SDI-100**.

(iii) Doors shall be mortised, reinforced and function holes provided at the factory in accordance with the hardware schedule and

templates provided by the hardware supplier. Through bolt holes, attachment holes, or drilling and tapping for surface hardware, shall be done by others in the field.

(d) Door material and construction

(i) Sheets shall be 16 gauge thick made of commercial quality hot dipped zinc coated steel that complies with **ASTM A924** A60.

(ii) Vertical edges shall join the face sheets by a continuous weld extending the full height of the door. Welds are to be ground smooth and filled to make them invisible and provide a smooth flush surface.

(iii) Hinge reinforcement to be not less than 7 gauge (3/16") plate 1-1/4" x 9".

(iv) Reinforce the top and bottom of all doors with an inverted continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors shall have a steel closure channel screwed or welded in place at the top of door so the web of the channel is flush with the top of the face sheets of the door. Plastic fillers are NOT acceptable.

(v) Caulk all seams and metal junctions at top of door.

(vi) Doors shall have 20 gauge vertical steel stiffeners spanning the full thickness of the interior space between door faces. Stiffeners shall be spaced not more than 6” on center horizontally, and attached by spot welds spaced not more than 5” on center vertically. Spaces between stiffeners are to be filled with fiberglass insulation (Min. density 0.8#/cubic ft).

(e) Frame material and construction

(i) Frames shall be fabricated of 14 gauge commercial quality hot dipped zinc coated steel that complies with **ASTM A924** A60.

(ii) Frames shall be weld comer type. Apply a zinc rich primer over the grinding area, and finish with a matching prime paint.

(iii) All finished work shall be strong and rigid, neat in appearance, square, true and free of defects.

(iv) Jamb depths, trim, profile and backbends to be as scheduled and shown on accepted shop drawing.

(v) Hardware reinforcements are to be of the minimum standard gauges as listed in **ANSI/SDI-100**.

(vi) Hinge reinforcements to be 7 gauge steel.

(vii) Frames shall be mortised, reinforced, drilled and tapped at the factory for template mortised hardware in accordance with the accepted hardware schedule and templates provided by the hardware supplier. Where surface mounted hardware is to be applied, frames shall have reinforcing plates only; all drilling and tapping to be done in the field by others.

(viii) Dust boxes/mortar guards shall be no less than 26 gauge.

(ix) Frames are to be welded and have a steel spreader during shipping and handling. Spreader bars are for bracing only and are not be

used to size and install the frame.

(x) Except on weather-stripped frames, punch the stop for 3 silencers on single door and 2 on double door frames.

(f) Prime finish

Doors and frames are to be cleaned and chemically treated to insure maximum finish paint adhesion. AU surfaces of the door and frame exposed to view shall receive a factory applied coat of rust inhibiting primer.

The finish to meet the requirements for acceptance stated in **ANSI A224.1** "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces.". The prime finish is not intended to be the final layer of protection from the elements. Field painting using a good grade of paint to be provided in accordance with the recommendations of the door and frame manufacturer. For specialty types of finished coatings, the paint supplier shall also be consulted.

(g) Performance and test

(i) **ANSI A 250.4** - Physical Endurance Test with 4,000,000 cycles

(ii) **ASTM F476-76** - Security Test

(iii) **ASTM E330-84**, Structural Performance test with result 110 psf

(iv) **ASTM E 90-90**, Sound Transmission test with 41 STC rating

(h) Others

Designer trim type for galvanized steel doors, without screw fixing Square/Rectangular glazing beads for door leaves shall be manufactured from galvanized steel forming a bevelled edge feature. External bead fastened in position to internal face for added security. Inner bead shall be retained in position with spring clips with no visible fixing and finished as door leaf. The vision panels shall be installed in factory.

Single glazed clear non-wired fire glass to match fire rating specification and shall be clear tempered glass or approved equivalent for non-fire rated doors. Method of fixing shall be in accordance with manufacturer's instructions, using fire resistant gaskets recommendations.

Plant room metal doors **17.36D*** Plant rooms housing mechanical plants and noise generating equipment shall be provided with proprietary metal acoustic doors in factory-applied powder coating finish with heavy-duty stainless-steel door hinges, mortise lock with thumb-turn, overhead door closer and stainless-steel kick plates.

Doors shall be equipped with suitable release device to meet staircase pressurization if required. Plant room doors to exterior shall be of Grade 316 stainless steel doors to match with the overall design of the exterior façade system. Plant room doors to interior shall be faced with natural veneers or plastic laminates to match with the overall design theme of the interior

ADJUSTABLE STEEL LOUVRE FRAMES

Adjustable and fixed steel louvres and frames **17.37** Fixed louvres and frames shall be all hot-dip galvanized unless permitted otherwise by the SO.

Adjustable metal louvre frames and weatherstrips shall be obtained from an approved supplier and constructed in accordance with the following:

(a) Frames and clips shall be of 1.2 and 0.9 mm (minimum) steel sheet respectively. Clips shall be suitable for receiving 100, 150 or 230 mm wide and 6 mm thick glass blades, as required. Aluminium frames and aluminium or plastic clips may be supplied subject to approval.

(b) Frames shall be designed for hand or pole operation, as required, with single control and to automatically lock when closed.

(c) Weatherstrips shall be shaped metal strips of an approved design and thickness.

(d) Steel frames, clips and weatherstrips shall be hot-dip galvanized or electro-zinc plated on all surfaces prior to assembly.

(e) Where specified, provide 45 x 10 mm galvanized steel sub-frames for single side louvre frames, with necessary slotted adjustable lugs and screws for building in.

(f) Provide matching rustless screws, bolts and spacers etc. for coupling adjacent frames to form mullions, where required.

ROLLER SHUTTERS AND DOORS

Roller shutters and doors **17.41** Roller shutters and doors shall be supplied and fixed in accordance with the following:

(a) Steel roller shutters shall consist of horizontal hot dipped galvanised slats, which interlock through their entire length to form a continuous hinge. The shutters shall be designed to withstand a wind load calculated in accordance with the **Code of Practice on Wind Effects in Hong Kong** with a minimum pressure of 3 kPa on the entire surface area of the shutter or otherwise specified.

(b) Roller shutters shall be either:

(i) Self - closing.

(ii) Manually operated by an endless chain.

(iii) Electrically operated.

Self-closing shutters shall be operated manually through an internal self coiling mechanism by lifting handles or a pole and hook. The mechanism shall be adjustable to control the effort required to raise or lower the door.

(c) Shutters operated by means of an endless chain shall be fitted with a spur or worm reduction gear such that the shutter shall not fall or rise without manual operation of the chain.

(d) Electrically operated shutters shall comply with the **Code of Practice for Installation of Electrically Operated Sliding Gates, Sliding Glass Doors and Rolling Shutters** issued by the Electrical and Mechanical Services Department. The shutters shall be installed complete with electric motors, the associated overload protection, drive mechanism, limit switches, emergency stop, control buttons and other control devices required by the shutter manufacturer. The electrical installation of the shutter shall comply with the **General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region**, issued by the Architectural Services Department, and **Code of Practice for the Electricity (Wiring) Regulations,** issued by the Electrical and Mechanical Services Department.

(e) Shutters shall have a locking device, and in addition approved malleable iron shoot bolts shall be provided and fitted to the bottom bar at each end of all shutters to assist holding the shutter under high wind conditions.

(f) The horizontal steel barrel carrying the shutter curtain shall be of suitable diameter and strength to resist deflection, be rust proofed and have adequate counter balance springs to ensure the correct balance of the shutter in all positions.

(g) The shutter and its barrel shall be supported on brackets with adequate bearings. The brackets shall be provided with suitable fixings for attaching to the soffit, face or side of opening.

(h) The vertical channel guides shall be of galvanised steel of adequate size and depth to hold the shutter curtain under high wind conditions and they shall be provided with adequate fixings for attaching to the soffit, face, jamb or side of openings or at base and apex in the case of movable mullions.

(i) Hoods and casings shall be of galvanized steel of adequate gauge, or folded 3 mm thick aluminium panel fully supported and braced to prevent any sagging or distortion. Access doors or plates shall be provided at the appropriate places to enable routine inspection and servicing to be carried out.

(j) Screws, bolts and fixing lugs shall be supplied as necessary for the assembling and fixing of the steel roller shutters.

(k) All ungalvanized steel and cast iron shall be painted with one coat of rust inhibiting primer before despatch to Site.

(l) Full details of motors, gearing, drive mechanism and control mechanism shall be provided and obtain approval. The motors, the associated control and protective devices shall be suitable for operating on local electricity supply. Totally enclosed three-phase induction motors are preferred. The motors, driving gears, limit switches, and control mechanism shall be accessible for inspection and servicing. An isolating switch shall be provided to isolate the electricity supply during inspection and servicing. Adequate electrical power supply shall be provided to the isolating switch.

(m) Auxiliary manually operated gear shall be provided. The changeover should be easily effected without climbing up to the gearing drive mechanism to engage the gears for manual operation or disengage the manual operating gear for electrical operation.

(n) An interlock switch shall be provided to prevent the locked roller shutters from operating electrically and shall be fitted on a stationary part (such as the guide rails) but not on the moving part of the roller shutters.

17.41A* Automatically controlled vertical sliding rolling shutter shall be provided with safety devices and emergency stop, constructed of stainless steel, completed with lockset, pull handles/hand holds.

Recess in structure shall be provided such that clear opening is not reduced in full open position.

If false ceiling is not provided at the shutters location or the shutter hood cannot be properly covered up by false ceiling, Hairline stainless steel cladding (or matching adjacent finishes) shall be provided for housing the shutter hood.

Security Shutter and Doors

17.41B* Security roller shutters shall be provided with structural calculations to substantiate the roller shutter being capable to withstand the designed wind pressure in full compliance with the **Code of Practice on Wind Effects in Hong Kong** shall be

checked and endorsed by the Structural Designer and submitted to the Supervising Officer for record. All roller shutters shall also be in full compliance with the **Code of Practice for installation of Electrically Operated Sliding Gates, Sliding Glass Doors and Rolling Shutters** published by Electrical and Mechanical Services Department.

Unless otherwise specified, security roller shutter for internal use shall be proprietary electrically operated roller shutter with 3mm thick polycarbonate panels in anodized aluminium frames.

Security roller shutter for external use shall be proprietary electrically operated solid grade 316 stainless steel roller shutter that shall be impact resistant and typhoon proof.

All shutters shall be provided with safety devices and emergency stop, completed with lockset, pull handles/hand holds.

Recess in structure shall be provided as necessary such that clear opening is not reduced in full open position.

If false ceiling is not provided at the shutters location or the shutter hood cannot be properly covered up by false ceiling, Hairline stainless-steel cladding or matching adjacent finishes shall be provided for housing the shutter hood.

All roller shutters, except for the transparent ones, are to be no. 8 mirror finished with concealed stainless steel guide rails and to be in full compliance with Electrical and Mechanical Services Department requirements.

Fire resisting shutters **17.42**

The construction and installation of the fire resisting shutter shall comply with the requirements of the **Code of Practice for Fire Safety in Buildings**, the Buildings Department. The activation devices shall be constructed according to the requirements of Fire Services Department. The operation of the fire shutter and the activation devices shall be tested according to the requirements of the **Codes of Practice for Minimum Fire Services Installations and Equipment and Inspection, Testing and Maintenance of Installations and Equipment**, the Fire Services Department and the **Testing and Commissioning Procedure for Fire Service Installation in Government Buildings of the Hong Kong Special Administrative Region**, the Architectural Services Department.

The fire rated period of the fire resisting shutters shall satisfy the criterion of integrity relating to the method of exposure on each side separately when tested in accordance with **BS EN 1634-1** to **3** or **BS 476-20** to **24**.

The fire shutter shall be accompanied with test certificates or reports issued by an Accredited Laboratory or Building Authority regarding the specified fire resisting period.

The fire resisting shutters shall be provided with smoke detector(s) and manual control devise(s) on both side of the wall openings for automatic and manual operation respectively. The detectors installed shall comply with the requirements of the **General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region**, the Architectural Services Department.

Sealant for metal **17.45**

The following requirements shall be complied with:

(a) VOC content limits on regulated adhesives stipulated in the Air Pollution Control (VOC) Regulation of Hong Kong.

(b) Shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride).

(c) Shall contain no more than 0.01% by wet weight of formaldehyde.

(d) Shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

17.45A* Window sealant, glazing Sealant, structural sealant, and control joins sealant shall be conformed to **BS 5889, BS 6213**, and **ASTM C1369** as appropriate. Colour of sealant to match with adjacent finishes.

METAL GATES

Metal gates **17.46** Metal gates shall be obtained from an approved manufacturer and constructed to **BS 4092-1** and in accordance with the following:

(a) When fixed in position, gates shall be designed to withstand a wind load calculated in accordance with the **Code of Practice on Wind Effects in Hong Kong** with a minimum pressure of 3 kPa and a permissible maximum deflection of 1/180 of the length of the member under consideration. Calculations shall be required to be submitted for approval.

(b) Design for the elements of the gate framework, post support and the connection to fix the gate framework to the surrounding structure shall be provided to demonstrate the stability of the metal gate during operation.

(c) For swing-type metal gates, all hinge fittings shall be welded all round to the gate framework and shall be able to withstand the dead weight of the metal gate and wind loads during operation. A minimum of 3 hinges shall be provided for the connection between the metal gate and each supporting post. One of the hinge fittings with the hinge pin pointing in a reverse direction shall be incorporated for providing restraint against vertical movement.

(d) For sliding metal gates, provide guide and end stoppers to maintain lateral stability of the metal gate and to resist the imposed loads and impact force. Similar provisions shall be provided for multi-passing metal gates.

(e) For folding metal gates with two or more hinged leaves, guided and/or supported at the top or at the bottom, clauses 17.46 (c) and (d) shall be complied with.

(f) Electrically operated metal gates shall comply with the **Code of Practice for Installation of Electrically Operated Sliding Gates, Sliding Glass Doors and Rolling Shutters** issued by the Electrical and Mechanical Services Department. The electrical installation of the shutter shall comply with the **General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region**, issued by the Architectural Services Department, and **Code of Practice for the Electricity (Wiring) Regulations**, issued by the Electrical and Mechanical Services Department.

(g) All members shall be hot-dip galvanized or zinc sprayed as specified in Clause 17.21.

(h) Paint surfaces: as specified in Section 21. Metal gates shall be delivered to site unprimed.

CAT LADDERS, GUARDS, RAILING AND BOLLARDS

Cat Ladder, Guards, Railings, Bollards, Gate & Fence **17.48*** The following requirements shall be complied with:

(a) Generally, to be constructed of stainless steel (grade 316) of hairline/satin

finish. Cat ladders, guards, railings and bollards shall be provided to facilitate easy and safe access for maintenance of the facility where required, for guarding against changes of levels along stairs, steps and ramps, for assisting barrier free accesses, for segregation of pedestrian and vehicular traffic and similar purposes where appropriate.

(b) Cat ladders shall be constructed of 38mm nominal diameter grade 3 1 6 stainless steel tubular strings, 20mm thick stainless steel flat rungs at 300mm centres and complete with 42mm nominal diameter stainless steel tubular brackets at 900mm centres and built into wall. Strings shall be continued above top of tanks and. If so required, bent or fishtailed at ends for building in and securely stabilized.

(c) Guards for lift machine room platforms shall be removable for ease of maintenance. Minimum size of stainless-steel sections shall be 150mm diameter for bollards, 75mm diameter for guards and 100mm diameter for railings. These barriers installed to restrict or control the movement of persons shall be designed to resist the minimum horizontal imposed loads as stated in **Code of Practice for Dead and Imposed Loads** published by Buildings Department.

(d) Bollards shall be stainless steel (grade 316) of hairline/satin finish.

(e) Textured finishes such as wood or aluminium should be provided for handrails and bollards in areas which is accessible to public, staff and visitors. Sharp edges should be avoided.

(f) Internal devices to be installed inside water tanks such as cat ladder shall be stainless steel grade 316.

Atmospheric Corrosion steel Plate (Corten Steel)

Atmospheric Corrosion steel Plate (Corten Steel) **17.49***

(a) Corten steel shall be external and internal compatible.

(b) The general thickness of the atmospheric corrosion steel plate is 3-4mm, and grade of Baosteel B480.

The dimensional quality standard of the atmospheric corrosion steel plate shall be in accordance as follows:

Length	< or =2m	±1.5mm
	> 3 m	± 2mm
Width	< or =1.2m	±1.5mm
Diagonal deviation		< or =3mm
Flatness		1 mm in 2 m length
Comer diameter		> lmm , < 2mm

(c) All steel surfaces prior to treatment of surface corrosion - will be fully abrasive shot blasted to remove all rust , dirt, mill scale and all other foreign materials.

(d) Protective Coating on the back of the atmospheric corrosion steel plate

A protective coating with dry film thickness of 60 microns to the back of steel plates.

Protective coating (back side) shall be as follows:

Test	Requirements

Salt Water resistant (24 hours)	No bubbling , No rust, and No color change
Resistance to Acidic solution (30 days)	No bubbling and peeling
Resistance to Alkaline solution (20 days)	No bubbling and peeling
Heat resistant (24 hours)	No bubbling , No rust, and No color change
Salt vapor resistant (200 hours)	No bubbling , No rust, and No color change

(e) The sub-frame should be done with welding before the surface corrosion process. Welding quality:

(i) Discontinuous welding length is not less than 25mm long; weld joints height is not less than 3mm;

(ii) Joints to be welded should be full and welded surfaces and steel plats needs to be surface grinding.

(iii) Makes good to the surfaces after welding free of bumps spots.

(f) The surfaces of the atmospheric corrosion steel plate to be formed corroded layers - entire production process must be done in factory and the quality is strictly controlled by manufacturer's supervision.

The treated thickness will be 40 microns of atmospheric corrosion steel plate after corrosion processing.

Column Guard

Column Guard **17.50*** Column and comer guards, unless otherwise specified, shall be constructed of 75 x 75 x 5mm galvanized mild steel angle sections, cast in the concrete, flush with the surrounding finished surfaces and of not less than 1500mm (or to suit the height of servicing vehicles) above adjacent finished floor level to adequately protect the structure against damage from vehicular impact. Column guards shall be finished with approved polyester polyurethane coating system.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 18

FINISHES

SECTION 18
FINISHES

RENDERING

Cement **18.1** Ordinary Portland Cement shall be to **BS EN 197-1 (**Type CEM I**)**.

18.1A* White or coloured cement is to be accepted brand and of the colours required for the work. It is to be delivered to the site in sealed drums bearing the name of the manufacturer and the brand of cement

Water **18.2** Water shall be as Clause 6.35.

Sand **18.3** Sand for mixes not incorporating lime shall be clean hard durable crushed rock or clean sand free from salt to conform to the grading limits set out in Table 18.1.

TABLE 18.1
Grading

B.S. Sieve	Percentage by weight passing B.S. Sieve
5.00 mm	100
2.36 mm	90 - 100
1.18 mm	70 - 100
0.60 mm	40 - 80
0.30 mm	5 - 40
0.15 mm	0 - 10

Sand for mixes incorporating lime shall be clean sand free from salt to conform to the grading limits set out in the Table 18.2

TABLE 18.2
Grading

B.S. Sieve	Percentage by weight passing B.S. Sieve
2.36 mm	100
1.18 mm	90 - 100
0.60 mm	55 - 100
0.30 mm	5 - 50
0.15 mm	0 - 10

18.3A* Where screeds, backing tiles, rendering, plastering or other finishes are to be used externally, the use of sea sand washed or otherwise will be strictly prohibited. Crushed granite fines are to be used for the backing coat and pointing of all external ceramic, quarry, or glass mosaic, etc. tiles.

Lime **18.4** Lime shall be as Clause 9.15.

18.4A* To be well burnt or chalk lime which has been run to putty and sieved through a 3 mm sieve into a maturing tank at least one month before use, or alternatively hydrated high calcium lime to comply with B.S. EN 495-1 (2010), which has been run to putty 24 hours before use.

Lime putty **18.5** Lime putty shall be as Clause 9.16.

Admixtures and additives **18.6** Admixtures and additives shall be as Clause 6.36.

18.6A* The use of plasticisers will be allowed subject to strict adherence to the manufacturer's instructions. Plasticisers to be an accepted proprietary brand to BS EN 934-3.

Bonding Agent **18.7** Bonding agent shall be compatible with background and finish, designated to be suitable for internal or external use and shall be an approved proprietary brand.

The approved proprietary bonding agent shall be used in strict accordance with the manufacturer's technical specifications and recommendations, including and not limited to the valid shelf life of the product. The expiry date shall be clearly indicated with label and stamp for necessary inspection by the SO.

18.7A* Bonding agent designated shall be suitable for external use in Hong Kong conditions. The Contractor shall submit the Manufacturer's specification and test certificates. The bonding agent shall meet the following requirements:

Ethylene vinyl acetate liquid admixture based. SBR Polymer is strongly prohibited. Should not contain aromatic group which prevent the heat break down.

Adhesion to concrete:
2.5N/mm2(SlurryCoat)
>2.0 N/mm2 (Spatterdash)
Solid content of at least 45% according to BS 5270
Acid value of less than 0.15mg of KOH according to BS 5270
Ash value of less than 0.1% by mass according to BS 5270

PLASTERING AND RENDERING

Steel lathing **18.24** Steel lathing shall be to **BS EN 13658-1** & **BS EN 13658-2** from an approved manufacturer:

(a) Plain expanded type of 6 mm short way mesh coated with tight coat galvanizing and weighing not less than 1.6 kg/m^2.

(b) Ribbed expanded type similarly coated and weighed not less than 2.25 kg/m^2.

Metal beads
Plastic beads **18.25** Galvanized steel corner beads, plaster stops and movement joint beads shall have expanded metal wings and be from an approved manufacturer.

Plastic corner beads shall be used if approved by the SO.

18.25A* Provide and fix proprietary galvanised mild steel corner beads, plaster stops and movement joints including nailing, stapling or fixing with plaster dabs and trowel the finishing coat flush with the bead in accordance with the General Specification for Building 2022 Edition issued by ArchSD.

Wire netting **18.26** Wire netting shall be to **BS EN 10223-2**, of 0.9 mm galvanized wire and 50 mm mesh.

Staples **18.27** Staples shall be galvanized steel wire staples.

Tying wire **18.28** Tying wire shall be 1.25 mm annealed steel wire, galvanized to **BS EN 10244-2**.

Gypsum plasters **18.29** Gypsum plaster shall be Retarded hemihydrate gypsum plaster to **BS EN 13279-2** & **BS EN 13279-1**, Class B of the following types:

Undercoat Plaster

Type a - 1 Browning plaster
2 Metal lathing plaster

Final Coat Plaster

Type b - 1 Finish plaster
2 Board finish plaster

18.29A* Comply with BS EN 13279-2 : 2004 and BS EN 13279-1 : 2008 Type B. Finishing plaster used on an undercoat of cement sand is to be of Retarded hemihydrate gypsum plaster of Type B.

Skim Coat Plasters **18.29B*** All plasters shall be cement based, ready-mixed and pre-packed. Skim coat performance shall comply with BS 6319 and shall only be mixed with water by machine / Mechanical mixer for a required time before application in accordance with manufacturer's specification.

The Proprietary Skim Coat (Internal wall) shall be fulfilled the standards and physical performance:
Europena Norm : EN 1015:2000
British Standard : BS 3900: 1993, BS 6319 : 1983
Chinese Standard : JG/T 3049-1998 : Type SZ N 0.50, GB18528-2001

Adhesion to Concrete	(JG/T 3049: 1998, EN 1015 Part 12) Initial Immerse in water	 > 0.7 N/mm^2 > 0.5 N/mm^2
Compressive Strength	Compressive Strength (BS 6319 : Part 2 : 1983, EN 1015 Part 11):	> 5 N/mm2
Flexural Strength	(BS 6319 : Part 3 : 1983)	> 2 N/mm^2
Shrinkage	(Coutinho Ring, HKHA MTS(2002/2004) Spec. Part D, Cl. 2.1.6)	: Nil
Mould Resistance	(BS 5980 : 1980)	No Mould Growth
Water Resistance	(BS 3900: G5: 1993, JG/T: 3049 : 1998)	Resistance to water immersion
Water Retentivity	(BS 4551 : 2005)	>99%
VOC Content	(GB18582 : 2001)	<50g/L
Alkaline Resistance	(BS 3900: G5: 1993, JG/T 3049 : 1998)	Resistance to alkaline immersion
Formaldehyde Content	(GB18582 : 2001)	< 0.1 g/kg

Unless specified, all technical data are average values and refer to 28 days curing time.

The Proprietary Skim Coat (ceiling) shall be fulfilled the standards and physical performance:

European Norm: EN 1015 : 2000
British Standard : BS 4551:2005, BS 6319 : 1983
Chinese Standard : JG/T 157:2004, GB18528-2001

Adhesion to Concrete	(JG/T 157: 2004, EN 1015 Part 12) Initial Immerse in water After Heat Ageing After Freeze-thaw Cycle	 > 1.0 N/mm^2 > 0.7 N/mm^2 > 0.7 N/mm^2 > 0.7 N/mm^2
Compressive Strength	(BS 6319 : Part 2: 1983, EN 1015 Part 11):	> 6 N/mm^2
Flexural Strength	(BS 6319 : Part 3 : 1983)	> 2 N/mm^2

Shrinkage	(Coutinho Ring, HKHA MTS(2002/2004) Spec. Part D, Cl. 2.1.6)	: Nil
Mould Resistance	(JC/T 547 : 1994)	No Mould Growth
Water Resistance	(JG/T 157 : 2004)	Resistance to water immersion
Water Retentivity	(BS 4551 : 2005)	>99%
Alkaline Resistance	(JC/T 157 : 2004)	Resistance to alkaline immersion
VOC Content	(GB18582 : 2001)	<200g/L
Formaldehyde Content	(GB18582 : 2001)	< 0.1 g/kg

Unless specified, all technical data are average values and refer to 28 days curing time.

Pre-mixed Skim Coat Plaster on Premixed Rendering **18.29C*** The physical property of the base plaster shall comply with the followings:

Adhesion to concrete	JC/T 157, JG/T 3049: 1998,HKHA MTS (2002/2004) Spec. Part D, Cl. 2.1.15 Initial Immerse in water	 0.7 N/mm^2 0.4 N/mm^2
Compressive strength	BS 6319 : Part 2 : 1983, HKHA MTS(2002/2004) Spec. Part D, Cl. 2.1.1	8N/mm^2
Flexural strength	BS 6319 : Part 3 : 1983	3N/mm^2
Shrinkage	Coutinho Ring, HKHA MTS (2002/2004) Spec. Part D, Cl. 2.1.6	Nil
Mould resistance	JC/T 547 : 1994	No mould growth
Water resistance	JG/T 3049 : 1998	Resistance to water immersion
Alkaline resistance	JG/T 3049 : 1998	Resistance to alkaline immersion
VOC content	GB18582 : 2001	< 50 g/L
Formaldehyde content	GB18582 : 2001	< 0.1 g/kg

Plasterboard **18.31** Plasterboard shall be to **BS EN 520+A1**, "gypsum lath" or "gypsum baseboard" with square edges.

Nails for plasterboard **18.32** Nails for "lath" or "baseboard" shall be 30 x 2.6 mm plasterboard galvanized steel nails, jagged shank type to **BS 1202-1**.

(a) 30 x 2.65 mm for plasterboard not exceeding 12.7 mm thick.

(b) 40 x 2.65 mm for plasterboard 19 mm thick.

Fire cement **18.37** Fire cement shall be as specified for firebrick mortar in Clause 9.22(c).

PREMIXED PLASTER

Generally **18.57** Premixed plaster shall be factory-produced by weighted combination of plaster raw materials and chemicals and supplied to sites in bags. Mixing with clean water shall be required before application.

Type of premixed plaster **18.58** There are two types of premixed plaster, cement based and gypsum based. Gypsum based is for internal use only.

Cement based premixed plaster **18.59** Cement based plaster contains mineral filler material as aggregate and Portland cement as main binder, with additives for improved compressive strength and reduced shrinkage.

Gypsum based premixed plaster **18.60** Gypsum based plaster contains pre-mixed minerals, gypsum base rendering materials and additives which could be applied in one single thick application without cracking and separation from the substrate.

Standards and ISO Certification **18.61** The premixed plaster shall comply with **BS 8481, BS EN 13279-1, BS EN 13279-2, BS EN 13914-1**, **BS EN 13914-2** and **PD/CEN/TR 15123**. The premixed plaster manufacturing company shall have acquired ISO certification in their manufacturing process of the premixed plaster product.

SCREEDS

Aggregate for light-weight screeds **18.71** Aggregate for lightweight screeds shall be as follows:

(a) 5 mm exfoliated vermiculite to **BS EN 13055**.

(b) Approved proprietary lightweight beads or granules.

Air entraining agent for light-weight screeds **18.72** Air entraining agent for lightweight screed shall be an approved admixture which will produce screeds with a dry density not more than 1,200 kg/m^2.

Self-levelling screeds **18.72A** The self-levelling screeds system shall be an approved proprietary system installed by an approved applicator. The floor screeds generally shall be to **BS EN 13813** and as Clause 18.89.

The system shall be smooth to receive flexible tile or sheet finishes, paint or other finishes as required by the SO.

Vapour barrier **18.73** Vapour barrier shall be 0.08 mm polythene sheet.

IN-SITU FLOOR AND WALL FINISHES

Stone aggregate **18.83** Stone aggregate shall be crushed grey granite or white stone to **BS EN 12620+A1**, graded from 10 to 3 mm and free from dust.

Marble aggregate **18.84** Marble aggregate shall be angular crushed marble, free from dust, and of the colour required.

Surface hardener **18.85** Surface hardener shall be an approved proprietary liquid hardener and dust proofer.

Hardening admixture **18.86** Hardening admixture shall be an approved proprietary make.

Dividing strip **18.87** Dividing strip shall be aluminium, brass, Grade 316 stainless steel or plastic strip 3 mm thick and to the full depth of the screed. Plastic strip shall be of the colour required.

Form key as one of the following:

(a) Generally sides of section shall be grooved.

(b) Metal strip: one edge shall be cut and bent at 150 mm centres, to form lugs.

(c) Plastic strip: to have 5 to 10 mm holes at 150 mm centres with plastic pins inserted to form dowels.

Non-slip strip **18.88** Non-slip strip insert shall be 25 x 15 mm slightly curved on top and consisting of:

(a) A compound of cement and carborundum dust 1:1, or

(b) A proprietary insert strip.

RIGID TILE OR SLAB FINISHES

Concrete floor tiles **18.102** Plain concrete or granolithic concrete floor tiles shall be of the required colour and surface finish.

Ceramic floor tiles and floor quarries **18.103** Ceramic floor tiles including corresponding accessories, shall be to **BS EN 14411**.

Ceramic floor tiles shall be Group A I or B I: water absorption not exceeding 3%.

Floor quarries shall be to Group A IIb of **BS EN 14411**: water absorption of 6% < E =< 10%.

Where ceramic floor tiles or clay floor quarries are described as "including specials" the full range of BS fittings shall be required. Elsewhere mitred angles of coved skirtings and the like shall be permitted.

All tiles and fittings shall be from the same manufacturer and shall match in colour and texture.

Where tiles are described as anti-slip, they shall be suitably embossed or treated with carborundum or similar grit to comply with relevant standards, e.g. Germany DIN standard or other recognized international standards to provide an anti-slip surface.

Anti-Slip Homogeneous Ceramic Tile Flooring **18.103A*** All anti-slip homogeneous ceramic tiles shall achieve static coefficient of friction for wet surface of not less than 0.5 when tested in accordance with ASTM C1028-07.

Terrazzo floor tiles **18.104** Terrazzo floor tiles shall be to **BS EN 13748-1+A1** & **BS EN 13748-2** and of the required colour and surface finish.

"Canton" tiles **18.105** "Canton" tiles shall be hard, sound, square, well burnt, free from twist, cracks or other defects, 30 to 35 mm thick and from 300 to 400 mm^2.

Concrete roofing tiles **18.106** Concrete roofing tiles and fitting shall be to **BS EN 490+A1** and **BS EN 491**.

The tiles shall be flat tiles 30 mm thick and 300 mm2 or 35 mm thick and 400 mm2.

18.106A* Precast concrete roofing tiles shall conform to the General Specification for Building (2022 Edition) or anti-slip ceramic floor tiles to BS EN 14411 with Solar Reflectance Index higher than 78 to satisfy the credit assessment requirement under Site Aspects in the Building Environmental Assessment Method (BEAM) Plus for New Buildings.

18.106B* Concrete roofing tiles are to be flat and square in shape, and either 37 x 450 x 450mm or 50 x 595 x 595mm or as shown on the Drawings, of precast vibrated concrete in the following proportions by volume : 1 part Portland cement, 2 parts clean washed sand, 4 parts 3mm to 12mm granite aggregate, free from dust.

18.106C* Concrete gutter tiles are to be shaped as shown on the Drawings with precast vibrated concrete in the following proportions by volume : 1 part Portland cement, 2 parts clean washed sand, 4 parts 3mm to 12mm granite aggregate, free from dust. Reinforcement comprising 3mm m.s. galvanised bars at 50mm c/c both ways to be included for both roofing and gutter tiles.

Insulating roofing tiles **18.107** Insulating roofing tiles shall be 40 mm thick and 300 mm^2 or 400 mm^2 with a density of 1,250 kg/m^3 ± 10%. The upper surface shall be hard and suitable for pedestrian traffic. Five legged tiles shall not be permitted.

External glazed ceramic wall tiles **18.108**

External glazed ceramic wall tiles shall be to **BS EN 14411** and in Group A IIa or B IIa with a water absorption not exceeding 6%.

Tiles shall be glazed, white or coloured as required and with cushion edge and with inclusive spacer lugs as required by the SO.
Where antimony, cadmium or lead (or any of their compounds) are used in the glazes, their content shall not exceed the following specific limits:

(a) Antimony: 0.25% in weight of the glazes
(b) Cadmium: 0.1% in weight of the glazes
(c) Lead: 0.5% in weight of the glazes

Inner face of parapet walls **18.108A***

FOR UPPER ROOFS AND MAIN BUILDING ROOFS (AREAS ONLY ACCESSIBLE FOR MAINTENANCE STAFF ONLY)

Inner face of parapet walls shall be finished with 18mm thick reconstituted granite tiles or other external homogeneous wall tiles, artificial granite external wall tiles, shall be fixed by proprietary tile setting mortar and grouting systems. Alternatively, 3mm thick aluminium cladding panels of same quality as of external wall cladding shall be provided.

ROOF TERRACE (AREAS ACCESSIBLE FOR PUBLIC AND/OR STAFF INCLUDING EXTERNAL LANDSCAPED AREAS AT GROUND LEVEL)

Inner face of parapet walls shall be finished with either 3mm thick aluminium cladding panels of same quality as of external wall cladding and/or natural granite stone panels.

Concrete roofing tiles **18.108B***

Install Fortified mortar in compliance with current revisions of ANSI A108.02 (3.11), A108.1B and ANSI A108.5.

Internal / External Wall Tiles **18.108C***

The external wall tiles shall have hydrophilic self-cleaning function.

All tiles and fittings shall comply with the requirements of B.S. 1281 and shall be of accepted manufacture and guaranteed non-crazing.

External facing tiles **18.109**

External facing tiles shall be of the specified type from an approved manufacturer.

Mosaic tiles **18.110**

Unless otherwise specified mosaic tiles shall be from an approved manufacturer and as follows:

(a) Glass mosaic tiles shall be fully vitrified glass tile size 20 x 20 mm and 4 mm thick, regular in shape, free from cracks or sharp edges and uniform in colour and texture.

(b) Glazed ceramic mosaic tiles shall be similar to glazed wall tiles but size 18 x 18 mm or 25 x 25 mm and 5 mm thick and with square edges.

(c) Unglazed vitreous mosaic tiles shall be size 18 x 18 mm or 18 x 38 mm or 38 x 38 mm and 4 or 5 mm thick with matching coved tiles and from the colour range specified.

Stone slabs **18.111**

Stone slabs for paving or wall facings or fittings shall be of the quality and colours specified on drawings or as selected by the SO and free from flaws and defects throughout. Unless otherwise specified, slabs for wall facings shall not be less than 20 mm thick and slabs for paving surfaces shall not be less than 32 mm thick.

Stones shall be jointed so as to be dressed to match stone by stone.

No stone shall be offered by quarries where variety is expected to develop or which deviates from the selected stone.

Marble shall be true metamorphic limestone.

Engineered Stone **18.111A** Prefabrication of engineered stone for paving or wall facings or fittings, including the processes used to install, modify or repair the engineered stone such as cutting, grinding, trimming, drilling, sanding, or polishing which generate silica dust shall be off-site in a controlled environment with adequate ventilation. Appropriate personal protective equipment shall be provided to prevent workers from inhaling dust particles.

Measures to prevent inhalation of silica dust shall be submitted for the SO's approval and implemented for on-site installation, modification and repairing of the engineered stone.

Sintered Stone / Large Format Porcelain Tile **18.111B*** Sintered stone slab / large format porcelain tile shall be resistant to freezing and highly resistant to stains, scratches and water. Low water absorption prevents the formation of normal stains and makes cleaning faster and easier.

Reconstituted Stone Panels **18.111C*** The quartz-based reconstituted stone panels should be hard, durable, maintenance free and non-water absorbing. It should be durable, with high resistance against scratches, impacts, acid and alkalis with a minimum thickness of 20 mm for wall finish and 30 mm for floor finish. The quartz-based reconstituted stone panels should achieve the following performance standards. Other equivalent international standards are also acceptable.

Density (EN 14617/1)	2.35 – 2.45 Kg/dm³
Surface Scratch hardness (EN 101)	:6 – 7 Mobs
Water Absorption (EN 14617/1)	: < 0.1%
Flexural Strength (EN 14617/2) :	:> 35 N/mm²
Abrasion Resistance (EN 14617/4)	: 139 – 275 mm³
Compressive Strength (EN 14617/15)	: > 110 Mpa
Fire Resistance (EN 13501/1)	: A2 fl – S1
Chemical Resistance (EN 14617/10)	: C4
Dimensional Stability (EN 14617/12)	: Class A
Linear Thermal Expansion (EN 14617/11)	: 23-26x 10 -6 oC -1

Precast concrete paving blocks **18.112** Precast concrete paving blocks shall be to **BS 7533-3+A1** & **BS EN 1338** and of the size, colour and surface textured specified.

Precast concrete paving blocks for landscape works **18.112A*** The cement used in the manufacture of the paving blocks should comply with British Standard : B12 Portland cement. The fine and coarse aggregates should consist of naturally occurring materials, crushed or uncrushed, complying with BS 882, 1201, coarse and fine aggregates from natural sources (including granolithic). The nominal maximum size of aggregate should not exceed 20 mm. The fine aggregate (passing a 5 mm sieve) should not contain more than 25% by weight of calcium carbonate in either the fraction retained on or the fraction passing a 600 mm BS sieve. Water should comply with the requirements of the Appendix of BS 3148 tests for water for making concrete. The cement content of the compacted concrete should not be less than 300 kg/cu.m.

Adhesive **18.113** Adhesive for tiles or mosaics shall be compatible with background and finish and shall be an approved proprietary brand. Adhesives for tiles shall be to **BS EN 12004-1**. Method statement specifying the types of equipment to be used, method of mixing, setting time and application time schedule shall be submitted for the SO's approval.

The approved proprietary adhesive shall be used in strict accordance with the manufacturer's technical specifications and recommendations, including and not limited to the valid shelf life and the setting time of the product, and the method statement approved by the SO.

The expiry date and the setting time shall be clearly indicated with label and stamp for necessary inspection by the SO.

The following requirements shall be complied with:

(e) VOC content limits on regulated adhesives stipulated in the Air Pollution

Control (VOC) Regulation of Hong Kong.

(f) Shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride).

(g) Shall contain no more than 0.01% by wet weight of formaldehyde.

(h) Shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

Tile Adhesive **18.113A*** Proprietary tile adhesive shall be improved cementitious adhesive complying with class C2TE of BS EN 12004:2007+A 1:2012 and fully compatible with background and finish. High initial tensile adhesive strength and other additional and/or special characteristics for specific service conditions shall be considered where appropriate to enhance the performance.

Slurry **18.114** Slurry shall be plain or coloured cement and water mixed to creamy consistency.

Grout **18.115** Grouts mixed with plain or coloured cement shall be:

(a) For floor tiling generally: cement and sand 1:3, mixed to a paste with the minimum of water.

(b) For mosaic tiling or glazed wall tiling: cement and powdered limestone 1:3.

(c) For external facing tiles: cement and sand 1:3.

If agreed by the SO, approved proprietary brands of grout may be used in strict accordance with the manufacturer's technical specifications and recommendations.

Epoxy grout **18.115A** Epoxy grouts shall be compatible with background and finish, designated to be suitable for internal or external use and shall be an approved proprietary brand. The grout shall be mixed in small quantities with all components in pre-measured ratios within its working time in accordance with manufacturer's technical specifications and recommendations.

Grouts shall be anti-fungal and resistant to solvents and oils.

Tile Grout **18.115B*** Unless otherwise specified, proprietary tile grout shall be cementitious improved grout complying with class CG2WA of BS EN 13888:2009 and fully compatible with background and finish. Application of grouting and surface preparation shall be in strict compliance with the manufacturer's instructions. Colour grouting should be available for selection from complete custom-ordered colours to match wall tiles.

Stone wall cladding **18.116** Material for stone wall cladding as in Clause 16.15 and sealant as in Clause 16.22.

Floor and wall tiling generally **18.117** Floor and wall tiling generally shall be:

(a) Floor tiling shall be to **BS 5385-3** & **BS 5385-5**.

(b) Internal wall tiling shall be to **BS 5385-1,** external wall tiling shall be to **BS 5385-2**.

(c) Buttering to Clause 3.2.1.8 in **BS 8000-0 & BS 8000-11**.

Floor tiling **18.117A*** Internal floor tiling shall be in accordance with BS 5385-3:2007.

Expansion joints **18.120** Allow for expansion with a 75 mm space around perimeter and 25 mm joints per 9 m^2 cut through joints and fill with cold bitumen or approved sealant.

18.120A* Proprietary expansion joint cover strips complying with ASTME-1399 Movement are to be installed for all exposed expansion joints, on internal floors and walls as follows:

Floor to floor or wall to wall - Mill finish aluminium clip strip MegAtec 280–A01 to suit joint width.

Floor to wall or wall to wall - Mill finish aluminium clip strip MegAtec 380–A02.

Emission	**18.129A**	Emission of formaldehyde from the approved proprietary products shall not exceed 0.13 mg/m^3 air.
Semi-flexible PVC tiles	**18.130**	Semi-flexible PVC tiles shall be to **BS EN ISO 10595**, size 225 x 225 or 300 x 300 and 2.5 mm thick.
Vinyl tiles	**18.131**	Unbacked flexible PVC (vinyl) tiles shall be to **BS EN ISO 10581**, size 225 x 225 or 300 x 300 and 2 mm thick.
Unbacked flexible PVC vinyl sheet	**18.132**	Unbacked flexible PVC (vinyl) sheet shall be to **BS EN ISO 10581**, 2.0 mm thick to floors and 1.2 mm thick to walls.
Homogeneous Vinyl Sheet	**18.132A***	Shall be flexible 2mm thick homogeneous monolayer vinyl sheet flooring to EN 685 (Classification 34/43) with abrasion resistant in Group T, in non-directional and multi-colour pattern, slip-resistance of R9, polyurethane reinforcement (PUR) with life-time wax and polished-free properties and good chemical resistance. The product's weight shall not be more than 3000g/m2 as defined in EN 430. The vinyl sheet shall achieve grade 6 or above when tested to BS EN ISO 105-B02 for colour fastness to light. TVOC emission after 28 days shall be not more than 10µg/m3 in accordance with BS ISO 16000-6. Wherever there is a higher risk of slip, slip resistant homogeneous vinyl flooring to EN 685 (Classification 34/43) with abrasion resistant in Group T shall be applied that shall have slip-resistance of R10 in accordance with DIN 51330. For room requiring radiation shielding, the finishes shall be acoustic absorbing and lint free. Lead-lined concrete wall or equivalent shall be adopted.
Heterogeneous Vinyl Sheet	**18.132B***	Multi-layer 2mm thick heterogeneous vinyl sheet flooring to EN685 (Classification 23/34/43) with specially formulated polyurethane reinforcement (PUR) with life-time wax and polished-free properties and good chemical resistance.
Anti-Static Dissipative Vinyl Sheet	**18.132C***	Minimum. 2mm thick heavy duty homogeneous vinyl sheet flooring to EN648 (Classification 34/43) with abrasion resistant Group P or above, polyurethane reinforcement (PUR) and good chemical resistance. All joints to be thermally welded. With regard to static dissipative properties, the flooring must conform to the requirements of IBM specifications. When tested to EN1081 R1/R2, the flooring must have a resistance of $<10^9$ ohms. When tested to DIN 51953 RA, the flooring must have a resistance between 1 x 10^6 to 1 x 10^9 ohms. Installation of grounding copper strip must be carried out strictly to instructions of PVC sheet flooring manufacturer. The vinyl sheet shall achieve grade 6 or above when tested to BS EN ISO 105-B02 for colour fastness to light. TVOC emission after 28 days shall be not more than 10µg/m^3 in accordance with BS ISO 16000-6.
Foam backed vinyl sheet	**18.133**	Foam backed PVC (vinyl) sheet shall be to **BS EN 651** and 3 mm thick overall. The wearing layer shall be PVC (vinyl) sheet to **BS EN ISO 10581** and 1.5 mm thick.
Resilient (Foam Backed) Vinyl Sheet	**18.133A***	Minimum 3.4mm thick foam backed vinyl sheet flooring to EN649 (Classification 23/34/43) and UPEC Classification (U4P3E2 / 3C2) with abrasion resistant Group P or above, polyurethane reinforcement (PUR) and good chemical resistance.
Linoleum	**18.134**	Linoleum tiles and sheet shall be to **BS EN 12104** and shall be 3.2 mm or 4.5 mm thick.
Rubber tiles and sheet	**18.135**	Solid rubber tiles and sheet shall be to 4 mm thick. The approved proprietary products shall have no flame retardant of polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs) or short-chain chlorinated paraffins added as formulated components. The product shall not contain any heavy metals or their compounds as listed below: (a) Arsenic (b) Cadmium (c) Chromium

(d) Copper
(e) Lead
(f) Mercury

Adhesive **18.136** Adhesive shall be that recommended by the tile or sheeting manufacturer. The following environment requirements shall be complied with:

(a) VOC content limits on regulated adhesives stipulated in the Air Pollution Control (VOC) Regulation of Hong Kong.

(b) Shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride).
(c) Shall contain no more than 0.01% by wet weight of formaldehyde.
(d) Shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

Tile Adhesive **18.136A*** Proprietary tile adhesive and cementitious improved grout as per Clause 1.10 of this Particular Specification shall be used for all wall tiling areas in accordance with BS 5385.

PVC Adhesive **18.136B*** The conductive adhesive used shall be accepted by the PVC sheet flooring manufacturer to ensure full product compatibility. VOC content of the adhesive shall be less than 50g/l. Vinyl sheeting shall be installed by accepted applicator in accordance with BS 8203.

CARPET OR TEXTILE FLOOR COVERINGS

Emission **18.144A** Emission of formaldehyde from the approved proprietary products shall not exceed 0.13 mg/m^3 air.

Emissions of Total Volatile Organic Compounds (TVOCs) shall not exceed 0.5 $mg/m^2/hr$.

Pile yarn **18.145** The composition of the pile yarn shall be fibres of one of the followings:

(a) Wool or wool blended with up to 20% nylon.

(b) Nylon with antistatic properties for general use.

(c) Polypropylene

(d) Blend of fibres with antistatic properties for general use.

(e) Blend of fibres formulated shall provide full antistatic properties to meet the requirements specified by International Business Machine (I.B.M.) or International Computer Company (I.C.L.) for computer floor coverings, or other equivalent approved by the SO.

Anti-Static carpet flooring **18.145A*** All carpet tiles shall be of tufted textured loop pile construction, pile weight not less than 20oz/sq. yard, nominal size of 600x600mm with anti-microbial treatment and permanent stain/soil protection, and shall be antistatic with less than 3.5kV permanent conductive filament. All fibres and yarns for the carpet tiles shall be 100% solution dye, with color fastness of not less than 4-5 in accordance with AATCC 16-E.

Backing materials **18.146** The warp and weft shall be PVC free, and the materials shall be cotton, jute, resin or polypropylene.

Back coating **18.147** The back coating where required shall be evenly spread with no build-up at the selvedges of the carpet and which gives fray-resistant finish to cut edges.

(a) The quality and application of the back coating shall be such that:

(i) Its penetration shall assist tuft anchorage without wicking into the surface pile.

(ii) The finish carpet may be seamed without gumming the needle and sewing thread, due to softening of the compound.

(iii) Folding the carpet shall not cause permanent creasing.

(b) The backing coating shall:

(i) Not deteriorate substantially with age or low temperature.

(ii) Not become sticky with temperatures and humidities experienced when laid in Hong Kong, or in transit thereto.

(iii) Be capable of spot cleaning using dry cleaning solvents without serious deterioration.

(c) The backing compound may be loaded with 100 parts of filler to 100 parts of dry rubber.

Dyeing **18.148** Carpets shall be dyed by a process that produces full and even penetration of the fibres with minimum degradation of the yarn and it shall be applied strictly in accordance with the dyestuffs manufacturer's instructions.

Colour fastness **18.149** Colour fastness of carpet shall meet the requirements of Table 18.8.

TABLE 18.8

Colour Fastness Related to	Minimum Acceptable Grade	Method of Test
Light	5	**BS EN ISO 105-B01, E01, B02, D02, G02, B03, B04, E05, C06, E06, X08, X13.**
Wet and dry rubbing	4	Pile yarn assembled and tested in accordance with **BS EN ISO 105-X12**
Shampooing	4	Test on finished carpet in accordance with the recommendations of the Society of Dyers and Colourists
Organic Solvents	4	**BS EN ISO 105-X05**

Physical properties **18.150** Physical properties of the finished carpet shall be in accordance with Table 18.9.

TABLE 18.9

Properties	Requirements	Method of Test
Number of tufts per 100 cm^2	Minimum 1,000	
Thickness loss under dynamic loading	Thickness loss after 1,000 impacts not more than 25%	**BS ISO 2094** Using dynamic loading machine on original pile thickness
Thickness; compression and recovery	Percentage compression recovery not less than 60%	**BS 4098** on original pile thickness
Dimensional stability; extension due to mechanical action	Mean non-recoverable not exceed Warp 1%, Weft 1%	to be decided by the SO

Dimensional change when immersed in cold water; to determine behaviour of the carpet when subjected to total saturation in cleaning or shampooing when excessive water is applied	Dimensional change not to exceed Warp 2%, Weft 2%	to be decided by the SO
Flammability	Shall not propagate flame after removal of nut and the charred area shall not exceed 35 mm radius	**BS 4790**
Moth proofing	The carpet shall be permanently moth proofed	to be decided by the SO

Resistance to wear **18.151** Although there is no standard laboratory test for resistance to wear, tenderers must satisfy the Employer that their products will sustain the wear anticipated. For example, they may quote tests or reports illustrating the suitability of their products, or list locations, preferably in Hong Kong where their products have been laid for a period of at least 2 years, or produce satisfactory evidence from overseas to endorse their suitability.

Foam backed carpet **18.152** Foam backed carpets shall not be permitted unless the foam is expanded PVC.

Carpet tiles **18.153** Carpet tiles shall be of the same size so that they could be easily interchanged, relocated, replaced or removed.

Special tiles, with proper edging around, cut out to receive floor socket or outlet are required.

All carpet surfaces shall be "Scotch-guarded", or other approved protective treatment to be provided. No unravelling of yarn at edge of module is permitted.

All carpet tiles shall be dimensionally stable (resist shrinkage) in any circumstance.

Environmentally friendly carpets **18.154** Environmentally friendly carpets shall satisfy the following criteria:

(a) Carpet manufacturing company shall have acquired "ISO 14001– Environmental Management Systems" or "Eco-Management and Audit Scheme (EMAS) of Denmark" or similarly approved by the SO.

(b) Carpets shall be completely free of Polyvinyl Chloride (PVC).

(c) Carpet backings shall be PVC free; materials to be cotton, jute, resin or polyurethane.

(d) Adhesives shall be free of synthetic latex, giving no volatile organic compound emission. Water-based adhesives or adhesive-free installation shall be used.

(e) Metal complex dyes and acid dyes shall not be used for dyeing.

(f) Carpets shall be long lasting, having a lifecycle not less than 10 years.

(g) Carpets shall not contain harmful substances and odour. They shall pass the testing and labelling program run by "Carpet and Rug Institute's Indoor Air Quality Carpet Testing Programme" (U.S.A.) or "Danish Indoor Climate Labelling" (Denmark) or "GUT" (European association for environmentally friendly carpets) or similarly approved by the SO.

(h) Carpets shall be capable of being reused, recycled into new carpet or other products, acceptable by landfill for disposal, or being refurbished. When reused, the above requirements shall be followed. In case of recycle or landfill, the carpets shall not cause contamination to the surrounding environment.

(i) The approved proprietary products shall include a post-consumer or post-industrial recycled content of at least 5% in the carpet face fibre, primary backing or secondary backing.

(j) The approved proprietary products shall not be manufactured with topically applied biological inhibitors.

Underlay **18.155** Provide underlay, where required, one of the following types to **BS EN 14499**.

(a) Felt
(b) Cellular
(c) Rubber crumb
(d) Composite underlay

Carpet grippers **18.156** Carpet grippers shall have two rows of small angled pins at not less than 50 mm centres projecting 4 mm from a preformed strip. Submit samples of carpet grippers and obtain approval.

Adhesives **18.157** Adhesive for fixing carpet shall be as recommended by the carpet manufacturers and be compatible with the sub-base. Storage and use should be in accordance with the appropriate recommendations, e.g. the British Adhesive Manufacturers Association booklet "Safe Handling of Adhesives in Industry".

The following environment requirements shall be complied with:

(a) VOC content limits on regulated adhesives stipulated in the Air Pollution Control (VOC) Regulation of Hong Kong.
(b) Shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride).
(c) Shall contain no more than 0.01% by wet weight of formaldehyde.
(d) Shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

Release bond agent **18.158** Release bond agent shall be a proprietary release coating or other approved system and be used strictly in accordance with the manufacturer's instructions.

RAISED ACCESSED FLOORING

Generally **18.164** The raised floor deck shall be fitted with fully removable load bearing panels, interchangeable, and supported on adjustable pedestals.

The floor system shall not contain materials which by direct contact could be detrimental to the safety and comfort of the users or which may emit abnormally toxic combustion materials and gases when burned.

The floor system shall be sturdy, rigid and firm. The design of the system shall prevent vibration, rattles, rocking squeaks and other noises. Floor panels that are cut shall be supported by additional pedestals and shall have framing modified accordingly.

Generally **18.164A*** The surface should be anti-static, non-combustible and non-slippery.

Dimensional requirements **18.166** All panels shall be of the following dimensional requirements:

(a) They shall be removable and fully transferable in position and direction.

(b) A close fit to all perimeters is required and the maximum gap shall be 15 mm and the edge panels shall be located to prevent movement.

(c) Before application of load, the platform floor surface shall be level to ± 1.5 mm over any 5 m^2 or ± 6 mm over the entire floor.

(d) Height difference between adjacent panels without finish, shall not exceed 0.75 mm, before load application. Height difference between loaded and not loaded shall not exceed 3.25 mm.

(e) Under no load condition, the concavity or convexity of the panel shall not exceed 0.75 mm when measured horizontally parallel to any edge or along the diagonal, and the deviation due to twist shall not exceed 1 mm.

(f) Panel deviation from square or work size shall not exceed ± 0.5 mm.

(g) Panel edge strips if utilised, shall be firmly fixed and shall not peel or become detached or break. The edging shall resist a pull off strength of 5 N for 5 minutes. Edge stripping shall be dimensionally stable during the stated service life.

Edges of panels shall be chamfered at an angle of 5 degrees for easy removal of panels. Site-cut edges of panels shall be treated to resist fire, moisture, and attack by vermin etc.

(h) The dead load of the raised access floor system shall not exceed 1 kN/m^2.

18.166A* The panel surface with anti-static high pressure laminate and 0.5mm thickness galvanized steel sheet on bottom, with fire retardant conductive edge trim and high-density (1500kg/m3) calcium sulphate non- combustible core fully comply with DIN 4102 non-combustible (F30 requirements). The floor panels shall be supported on a sub-structure with steel pedestals and steel stringers if require, which are fixed and bonded to the concrete floor surface by epoxy adhesive.

18.166B* All panels with the exception of cut panels, shall be square in shape with a work size of 600mm x 600mm. All panels are to be removable and fully transferable in position and direction.

Structural requirements

18.167 The structural requirements of the floor system shall be in accordance with the followings:

(a) Uniformly distributed load - 12.0 kN/$m^{2.}$
Concentrated load - 4 kN over 25 $mm^{2.}$
Deflection shall not be more than 1/250 of the shortest span or 2.5 mm whichever is less, up or down from the unloaded plane when subjected to the loadings quoted above, for a period of 24 hours.
Horizontal load - 1.2 kN/m^2.

(b) The system shall sustain for 5 minutes, 3 times the specified static loadings without collapse, at any position in the panel.

(c) Base area of the pedestal shall not be less than 10,000 mm^2 and shall be fixed to the floors by mechanical means in addition to adhesives.

(d) Pedestals shall not be permanently deformed by more than 1 mm per 100 mm in height when subjected to a steady horizontal moment of 90 Nm up to a maximum applied load of 0.5 kN, applied to the uppermost part, for 5 minutes.

They shall sustain a vertical load of 4 x 18 kN over an area of 50 x 50 mm for a period of 5 minutes without collapse and 3 x 13.5 kN applied through a panel over one quadrant of the head.

Free movement in an unloaded pedestal at the maximum and minimum adjustment position shall not exceed 1 mm per 100 mm height. The free movement shall be induced by the application of a horizontal force of 5 N.

The adjustable device on the pedestal shall be positively locked and shall be designed so as not to become loose due to vibration during the life of the system. It shall be possible to release the locking by means of a tool should re-adjustment become necessary.

The length of threading for the upper part of the pedestal shall not be less than 60 mm.

(e) Where a supplementary support structure is required to accommodate variations greater than construction tolerances, i.e. to bridge service ducts etc., such bridging shall comply with all the relevant requirements of the specifications.

Alternatively, the raised floor system can be tested for concentrated load, ultimate load, rolling loads, stringer load, pedestal axial load, pedestal overturning moment, uniform load and drop impact load according to Ceilings and Interior Systems Construction Association (CISCA) Recommended Testing Procedure, subject to approval by the SO.

18.167A* i. Pedestal Material

Pedestal shall be solid mild steel with electroplated coating of min. 5 micro factory applied zinc finish or be of electro-galvanized steel. Each pedestal shall consist of an anti-vibrational head cap with cruciform up stands and four panel locating studs, positively clipped to the steel top plate.

ii. Pedestal Fixing

Pedestal shall be fixed to the sub-floor by means of epoxy adhesive and shall not detach from the particular sub-floor when subjected to the site quality control pedestal fixing test detailed in sub-clause (f)(iv) of this Clause. The pedestal shall be designed to evenly transmit the static loads over the full area of the sub-floor. Fixings methods shall fully comply with the manufacturer requirement. Mechanical fixing is not recommended.

iii. Pedestal Stability and Strength

- Performance of pedestal shall comply with Flat Form Floors Raised Access Floors Performance Specification RAL GZ-941
- Pedestals shall not be permanently deformed by more than 1mm per 100mm in height when subjected to a steady horizontal moment of 90Nm up to a maximum applied load of 50 Kg applied to the uppermost part, for 5 minutes.
- Pedestals are required to sustain the following vertical load over an area of 50 x 50mm for a period of 5 minutes without collapse:

  - a vertical static concentration load of 72KN applied through the panels at the centre of the head;
  - a vertical static concentration load of 54KN applied through a panel over one quadrant at the centre of the head;
  - a vertical load 4 x 18 KN over an area of 50 x 50mm for a period of 5 minutes.
  - Without collapse 4 x 13.5 KN applied through a panel over one quadrant of the head.Free movement in an unloaded pedestal at the maximum and minimum adjustment position shall not exceed 1mm per 100mm height.
  - Free movement shall be induced by the application of a horizontal force of 5N.

Hydrothermal requirements

18.168 The platform floor system, including the pedestals, panels, floor covering and fixings shall withstand the following conditions, without any delamination or other forms of deterioration:

(a) Temperature 5°C, relative humidity 90% on both sides of the floor panels.

(b) Temperature 5°C and 95% RH in the floor void side of the panels. Temperature 25°C and 25% RH on the room side of the panels.

(c) Temperature 8°C and 99% RH in the floor void side of the panels. Temperature 23°C and 55% RH on the room side of the panels.

(d) Temperature 30°C and 30% RH in the floor void side of the panels, 19°C and 60% RH on the room side of the panels.

(e) Temperature variation from 0°C to 60°C with humidity level of 95%.

The material shall, under the above-mentioned conditions and after the above-mentioned conditions comply with the Clauses 18.166 and 18.167. The material content of the floor panels shall not be capable of absorbing moisture.

Fire and safety requirements **18.169** The system shall comply with the following fire and safety requirements:

(a) It shall be non-inflammable and shall not sustain any combustion.

(b) It shall meet the fire requirements of **BS 9999** and **Part E of the Code of Practice for Fire Safety in Buildings 2011.**

(c) It shall achieve, within the cavity, Class 1 classifications when tested in accordance with **BS 476-7** and an index of Performance (1) not exceeding 12 and a sub index (i) not exceeding 6 when tested in accordance with **BS 476-6+A1**. The test certificates shall be issued by an accredited laboratory not more than 3 years ago.

(d) Panels that are constructed of combustible material shall be completely and securely clad on the underside in non-combustible material with a melting point of not less than 600ºC. This cladding shall be securely fixed to ensure that flame or radiant heat does not come into contact with the combustible material.

(e) All supporting structure shall be incombustible and shall have a melting point of not less than 600ºC.

(f) It shall have a thermal property such that mean temperature of the upper panel surface shall not increase by more than 140ºC, when subject to the 1 kg crib fire test.

Electrical requirements **18.170** The system shall have the electrostatic properties such that the resistance between the surface of the floor covering and the main building earth continuity conductor shall be between 5 x 100000 and 2 x 10 to the power of 10 ohms at RH 50%.

All substantial metallic components of the floor system shall be capable of being electrically bonded.

Fungi, mould and insects **18.171** All materials shall be resistant to the growth of fungi and micro-organisms, and to the attack by insects.

The materials shall meet **BS 1982-0, BS 1982-1, BS 1982-2 and BS 1982-3** method of test for fungal resistance and manufactured building materials made of or containing materials of organic origin. The materials shall be accompanied with test certificates or reports, issued by an accredited laboratory.

Toxicity **18.172** The system shall not contain any toxic materials which by physical contact or by inhalation of gases from such materials, could prove harmful to the occupants of the building.

Odour **18.173** The materials used in the system shall not give off any odours which could be unpleasant to the occupants of the building.

Vermin **18.174** Materials used in the system shall not be vulnerable to attack by vermin. The design of the system should resist infestation by vermin.

Creation of contaminations **18.175** The system and the floor panels shall not create dust or contaminations which are likely to be harmful to personnel or equipment.

Durability **18.176** The system supporting components and the floor panels shall have a minimum life of 25 years.

Insulation of under cavity floor where required **18.178**

Materials shall be non-combustible and shall be approved by the Fire Services Department. They shall be compatible with all other materials used in the raised floor system.

For insulation, the conductivity shall not be more than 0.036 w/mºC at 24ºC.

The following environment requirements shall be complied with:

(a) Discharge of Volatile Organic Compounds (VOCs) shall not exceed 500 μg/m^2/hr.

(b) The levels of the following hazardous substances as impurities shall not exceed the following:
(i) Arsenic: 50 ppm
(ii) Cadmium: 10 ppm
(iii) Hexavalent chromium: 10 ppm
(iv) Lead: 300 ppm
(v) Mercury: 10 ppm
(vi) Selenium: 20 ppm
(vii) PBDEs (polybrominated diphenyl ethers): 100 ppm
(viii) PBBs (polybrominated byphenyls): 100 ppm

Polyurethance Insultated Panel **18.178A**

Wearing surface shall be made of 3 mm non-slip stainless steel checker plate or equivalent. The installation shall be waterproof and be constructed with prefabricated sandwiched panels comprising formed-in-place high density rigid insulating foam polyurethane (CFC-free, with appropriate thickness, density and thermal conductivity), sandwiched between 1 mm thick sheets of grade 316 electro polished stainless steel sheeting on internal and external surfaces.

QUALITY CONTROL TESTING

Non-slip homogenous floor tiles **18.184**

The quality tests for non-slip homogenous floor tiles shall be as follows:

(a) Dimensions and surface quality:

Test Items		Test Method	Acceptance Standards		
Nominal Size (mm)			200 x 200	300 x 300	400 x 400
BS EN 14411 Classification			BIb	BIb	BIb
1. Length and Width	Deviation from Work Size (%)	**BS EN ISO 10545-2**	± 0.75	± 0.6	± 0.6
	Deviation from Average Size (%)		± 0.5	± 0.5	± 0.5
2. Thickness (%)			± 5	± 5	± 5
3. Straightness of sides (%)			± 0.5	± 0.5	± 0.5
4. Rectangularity (%)			± 0.6	± 0.6	± 0.6
5. Surface flatness	Centre curvature (%)		± 0.5	± 0.5	± 0.5
	Edge curvature (%)		± 0.5	± 0.5	± 0.5
	Warpage (%)		± 0.5	± 0.5	± 0.5
6. Surface quality (%) free from visible defects that would impair the appearance of a major area of tiles			= > 95	> = 95	> = 95

(b) Physical properties:

Test Items		Test Method	Acceptance Standards		
Nominal Size (mm)			200 x 200	300 x 300	400 x 400
BS EN 14411 Classification			BIb	BIb	BIb
1. *Water absorption (%)	Average Individual	**BS EN ISO 10545-3**	< = 3 < = 3.3	< = 3 < = 3.3	< = 3 < = 3.3
2. *Modulus of rupture (N/mm^2)	Average Individual	**BS EN ISO 10545-4**	> = 30 >=27	> = 30 >=27	> = 30 >=27
3. *Scratch hardness of surface (Moh's Scale)		to be decided by the SO	> = 6	> = 6	> = 6
4. *Abrasion resistance	Deep abrasion (mm^3)	**BS EN ISO 10545-6**	< = 175	< = 175	< = 175
5. *Coefficient of linear thermal expansion ($x10^6$ °C)		**BS EN ISO 10545-8**	< = 9.0	< = 9.0	< = 9.0

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(c) Chemical properties:

Test Items		Test Method	Acceptance Standards		
Nominal Size (mm)			200 x 200	300 x 300	400 x 400
BS EN 14411 Classification			BIb	BIb	BIb
1. *Resistance to acids and alkali	Sulphuric acid	**BS EN ISO 10545-13**	Required	Required	Required
	Lactic acid		Required	Required	Required
	Potassium hydroxide		Required	Required	Required
2. *Resistance to household chemicals	Ammonium chloride		Required	Required	Required
	Standard cleaning agent		Required	Required	Required
3. *Resistance to swimming pool salts	Sodium hypochlorite		Required	Required	Required
	Copper sulphate		Required	Required	Required

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(d) Slip resistance:

Test Items		Test Method	Acceptance Standards		
Nominal Size (mm)			200 x 200	300 x 300	400 x 400
BS EN 14411 Classification			BIb	BIb	BIb
1.*Anti-slip property	External Areas				
	Ramps steeper than 1 in 14	**DIN 51130**	R12		
	Other external areas		R11		
	Internal Areas				
	Ramps steeper than 1 in 14	**DIN 51130**	R11		
	Ramps under 1 in 14		R10		
	Wet/ semi-covered area		R10		
	Other internal areas (excluding barefoot situations)		R9		

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

Internal glazed ceramic wall tiles

18.185 The quality tests for internal glazed ceramic wall tiles shall be as follows:

(a) Dimensions and surface quality:

Test Items		Test Method	Acceptance Standards		
Nominal Size (mm)			108 x 108	152 x 152	200 x 200
BS EN 14411 Classification			BIII	BIII	BIII
1. Length & Width	Deviation from Work Size (%)	**BS EN ISO 10545-2**	± 0.75 / (-0.3, +0.6)	± 0.5 / (-0.3, +0.6)	± 0.5 / (-0.3, +0.6)
	Deviation from Average Size (%)		± 0.5 / (± 0.25)	± 0.3 /(± 0.25)	± 0.3 / (± 0.25)
2. Thickness (mm)		To be decided by the SO	± 0.5	± 0.5	± 0.6
3. Minimum thickness (mm)			4	5.5	-
4. Straightness of sides (%)		**BS EN ISO 10545-2**	± 0.3	± 0.3	± 0.3
5. Rectangularity (%)			± 0.5 / (± 0.3)	± 0.5 / (± 0.3)	± 0.5 / (± 0.3)
6. Surface flatness	Centre curvature (%)		- 0.3, + 0.5 (-0.2 / +.8 mm)	- 0.3, + 0.5 (-0.2 / +0.8 mm)	- 0.3, + 0.5 (-0.2 / +0.8 mm)
	Edge curvature (%)		- 0.3, + 0.5 (-0.2 / +0.8 mm)	- 0.3, + 0.5 (-0.2 / +0.8 mm)	- 0.3, + 0.5 (-0.2 / +0.8 mm)
	Warpage (%)		±0.5 / (±0.5 mm)	±0.5 / (±0.5 mm)	±0.5 / (±0.75 mm)
7. Surface quality (%) free from visible defects that would impair the appearance of a major area of tiles			= > 95	> = 95	> = 95
8. Tile with spacer lugs	Width of tile grout at tiled surface (mm) (G)	To be decided by the SO	-	-	G = 3 mm ± 20%

Note: Values in brackets are for tiles with spacer lugs only.

(b) Physical properties:

Test Items		Test Method	Acceptance Standards		
Nominal Size (mm)			108 x 108	152 x 152	200 x 200
BS EN 14411 Classification			BIII	BIII	BIII
1. *Water absorption (%)	Average	**BS EN ISO 10545-3**	= > 10 & < = 20	= > 10 & < = 20	= > 10 & < = 20
2. *Modulus of rupture (N/mm^2)	Thickness <7.5 mm	**BS EN ISO 10545-4**	> = 15	> = 15	> = 15
	Thickness >=7.5mm		>=12	>=12	>=12
3. *Scratch hardness of surface (Moh's Scale)		to be decided by the SO	> = 3	> = 3	> = 3
4. *Abrasion resistance	Surface abrasion (Class1-4)	(PEI Method) **BS EN ISO 10545-7**	Minimum Class 2	Minimum Class 2	Minimum Class 2
5. *Coefficient of linear thermal expansion ($x10^6$ °C)		**BS EN ISO 10545-8**	< = 9.0	< = 9.0	< = 9.0
6. *Crazing resistance		**BS EN ISO 10545-11**	Required	Required	Required

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(c) Chemical properties

Test Items		Test Method	Acceptance Standards		
Nominal Size (mm)			108 x 108	152 x 152	200 x 200
BS EN 14411 Classification			BIII	BIII	BIII
1. *Resistance to acids and alkali	Hydrochloric acid	**BS EN ISO 10545-13**	Minimum Class B	Minimum Class B	Minimum Class B
	Citric acid		Minimum Class B	Minimum Class B	Minimum Class B
	Potassium hydroxide		Minimum Class B	Minimum Class B	Minimum Class B
2. *Resistance to household chemicals	Ammonium chloride		Minimum Class B	Minimum Class B	Minimum Class B
	Standard cleaning agent (See Note 2)		Minimum Class B	Minimum Class B	Minimum Class B
3. *Resistance to swimming pool salts	Sodium hypochlorite		Minimum Class B	Minimum Class B	Minimum Class B
	Copper sulphate		Minimum Class B	Minimum Class B	Minimum Class B
4. *Resistance to staining	Methylene blue	**BS EN ISO 10545-14**	Minimum Class B	Minimum Class B	Minimum Class B
	Potassium permanganate		Minimum Class B	Minimum Class B	Minimum Class B

Note: 1. For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

2. The cleaning agent used is "Bathroom Magiclean" available in supermarkets.

Ceramic Wall tiles **18.185A*** Ceramic wall tiles used in this project shall be of low water absorption (i.e. Group I) to BS EN 14411, with size not less than 200x200mm.

Ceramic Wall tiles **18.185B*** The manufacturer of the proposed ceramic tiles shall maintain a certified factory production control system conforming to BSEN ISO 9001 to ensure the performance of the ceramic tiles comply with the declared characteristics

Unglazed vitreous mosaic wall tiles **18.186** The quality tests for unglazed vitreous mosaic tiles shall be as follows:

(a) Dimensions and surface quality:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			20 x 20, 50 x 50
BS EN 14411 classification			BIb
1. Length and Width	Deviation from Work	**BS EN ISO 10545-2**	± 1.2
	Deviation from Average Size (%)		± 0.75
2. Thickness (%)			± 10
3. Minimum thickness (mm)		To be decided by the SO	4 (20 x 20)
			5 (50 x 50)
4. Straightness of sides (%)		**BS EN ISO 10545-2**	± 0.75
5. Rectangularity (%)			± 1.0
6. Surface flatness	Centre curvature (%)		± 1.0
	Edge curvature (%)		± 1.0
	Warpage (%)		± 1.0
7. Surface quality (%)free from visible defects that would impair the appearance of a major area of tiles			> = 95

(b) Physical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			20 x 20, 50 x 50
BS EN 14411 classification			BIb
1. *Water absorption (%)	Average	**BS EN ISO 10545-3**	0.5> & < = 3
	Individual		< = 3.3
2. *Modules of rupture (N/mm^2)	Average	**BS EN ISO 10545-4**	> = 30
	Individual		> = 27
3. *Scratch hardness of surface (Moh's Scale)		to be decided by the SO	> = 6
4. *Abrasion resistance	Deep abrasion (mm^2)	**BS EN ISO 10545-6**	< = 175
5. *Coefficient of linear thermal expansion ($x10^{-6}$ / °C)		**BS EN ISO 10545-8**	< = 9.0

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(c) Chemical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			20 x 20, 50 x 50
BS EN 14411 classification			BIb
1. *Resistance to acids and alkali	Sulphuric acid	**BS EN ISO 10545-13**	Required
	Lactic acid		Required
	Potassium hydroxide		Required
2. *Resistance to household chemicals	Ammonium chloride		Required
	Standard cleaning agent		Required
3. *Resistance to swimming pool salts	Sodium hypochlorite		Required
	Copper sulphate		Required

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

Glass mosaic tiles **18.187** The quality tests for glass mosaic tiles shall be as follows:

(a) Dimensions and surface quality:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			20 x 20
1. Length & Width	Deviation from Work Size (%)	**BS EN ISO 10545-2**	± 1.2
2. Thickness (%)			± 10
3. Minimum thickness (mm)		to be decided by the SO	4
4. Surface flatness	Centre curvature (%)	**BS EN ISO 10545-2**	± 1.0
	Edge curvature (%)		± 1.0
5. Surface quality (%) free from visible defects that would impair the appearance of a major area of tiles			> = 95

(b) Physical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			20 x 20
1. *Water absorption (%)	Average	**BS EN ISO 10545-3**	0.5< & < = 3
	Individual		< = 3.3
2 *Modules of rupture (N/mm^2)	Average	**BS EN ISO 10545-4**	> = 30
	individual		> = 27
3. *Scratch hardness of surface (Moh's Scale)		to be decided by the SO	> = 6
4. *Coefficient of linear thermal expansion ($x10^{-6}$ / °C)		**BS EN ISO 10545-8**	< = 9.0

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(c) Chemical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			20 x 20
1. *Resistance to acids and alkali	Sulphuric acid	**BS EN ISO 10545-13**	Required
	Lactic acid		Required
	Potassium hydroxide		Required
2. *Resistance to household chemicals	Ammonium chloride		Required
	Standard cleaning agent		Required
3. *Resistance to swimming pool salts	Sodium hypochlorite		Required
	Copper sulphate		Required

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

Homogenous coved tile skirting

18.188 The quality tests for homogenous coved tile skirting shall be as follows:

(a) Dimensions and surface quality:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			200 x 75 x 7
BS EN 14411 classification			BIb
1. Length & width	Deviation from Work Size (%)	**BS EN ISO 10545-2**	± 1.0
	Deviation from Average Size (%)		± 0.5
2. Thickness (%)			± 10(or to be decided by the SO)
3. Surface quality (%) free from visible defects that would impair the appearance of a major area of tiles			> = 95

(b) Physical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			200 x 75 x 7
BS EN 14411 classification			BIb
1. *Water absorption (%)	Average		0.5=< & < = 3
	Individual	**BS EN ISO 10545-3**	< = 3.3
2. *Scratch hardness of surface (Moh's Scale)		to be decided by the SO	> = 6
3. *Abrasion resistance	Deep abrasion (mm^3)	**BS EN ISO 10545-6**	< =175
4. Coefficient of linear thermal expansion ($x10^{-6}$ / °C)		**BS EN ISO 10545-8**	< = 9.0

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(c) Chemical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			200 x 75 x 7
BS EN 14411 classification			BIb
1.*Resistance to acids and alkali	Sulphuric acid	**BS EN ISO 10545-13**	Required
	Lactic acid		Required
	Potassium hydroxide		Required
2.*Resistance to household chemicals	Ammonium chloride		Required
	Standard cleaning agent		Required
3.*Resistance to swimming pool salts	Sodium hypochlorite		Required
	Copper sulphate		Required

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

Homogenous wall tiles

18.189 The quality tests for homogenous wall tile shall be as follows:

(a) Dimensions and surface quality:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			100 x 100
BS EN 14411 classification			BIb
1. Length & width	Deviation from Work Size (%)	**BS EN ISO 10545-2**	± 1.0
	Deviation from Average Size (%)		± 0.5
2. Thickness (%)			± 10
3. Straightness of sides (%)			± 0.5
4. Rectangularity (%)			± 0.6
5.Surface flatness	Centre curvature (%)		± 0.5
	Edge curvature (%)		± 0.5
	Warpage (%)		± 0.5
6.Surface quality (%) free from visible defects that would impair the appearance of a major area of tiles			= > 95

(b) Physical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			100 x 100
BS EN 14411 classification			BIb
1. *Water absorption (%)	Average	**BS EN ISO 10545-3**	0.5<= & < = 3
	Individual		< = 3.3
2. *Modules of rupture (N/mm^2)	Average	**BS EN ISO 10545-4**	> = 30
	Individual		> = 27
3. *Scratch hardness of surface (Moh's Scale)		to be decided by the SO	> = 6
4. *Abrasion resistance	Deep abrasion (mm^3)	**BS EN ISO 10545-6**	< = 175
5. *Coefficient of linear thermal expansion ($x10^{-6}$ / °C)		**BS EN ISO 10545-8**	< = 9.0

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(c) Chemical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			100 x 100
BS EN 14411 classification			BI
1. *Resistance to acids and alkali	Sulphuric acid	**BS EN ISO 10545-13**	Required
	Lactic acid		Required
	Potassium hydroxide		Required
2. *Resistance to household chemicals	Ammonium chloride		Required
	Standard cleaning agent		Required
3. *Resistance to swimming pool salts	Sodium hypochlorite		Required
	Copper sulphate		Required

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

External facing tiles **18.190** The quality tests for external facing tiles shall be as follows:

(a) Dimensions and surface quality:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			45 x 45 x 7 & 45 x 95 x 7
BS EN 14411 classification			BIb
1. Length and width	Deviation from Work Size (%)	**BS EN ISO 10545-2**	± 1.2
	Deviation from Average Size (%)		± 0.75
2. Thickness (%)			± 10
3. Straightness of sides (%)			± 0.75
4. Rectangularity (%)			± 1.0
5. Surface flatness	Centre curvature (%)		± 1.0
	Edge curvature (%)		± 1.0
	Warpage (%)		± 1.0
6. Surface quality (%) free from visible defects that would impair the appearance of a major area of tiles			= > 95

(b) Physical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			45 x 45 x 7 & 45 x 95 x 7
BS EN 14411 classification			BIb
1. *Water absorption (%)	Average	**BS EN ISO 10545-3**	0.5<= & < = 3
	Individual		< = 3.3
2. *Modules of rupture (N/mm^2)	Average	**BS EN ISO 10545-4**	> = 30
	Individual		> = 27
3. *Scratch hardness of surface (Moh's Scale)		to be decided by the SO	> = 5
4. *Abrasion resistance	Surface abrasion (Class1 – 4)	(PEI Method) **BS EN ISO 10545-7**	Minimum Class 3
5. *Coefficient of linear thermal expansion ($x10^6$ / °C)		**BS EN ISO 10545-8**	< = 9.0
6. *Crazing resistance		**BS EN ISO 10545-11**	Required

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

(c) Chemical properties:

Test Items		Test Method	Acceptance Standards
Nominal Size (mm)			45 x 45 x 7 & 45 x 95 x 7
BS EN 14411 classification			BIb
1.*Resistance to acids and alkali	Hydrochloric acid	**BS EN ISO 10545-13**	Minimum Class B
	Citric acid		Minimum Class B
	Potassium hydroxide		Minimum Class B
2.*Resistance to household chemicals	Ammonium chloride		Minimum Class B
	Standard cleaning agent (See Note 2)		Minimum Class B
3.*Resistance to swimming pool salts	Sodium hypochlorite		Minimum Class B
	Copper sulphate		Minimum Class B
4.*Resistance to Staining	Methylene blue		Minimum Class 2
	Potassium permanganate (See Note 2)		Minimum Class 2

Note: 1. For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

2. The cleaning agent used is "Bathroom Magiclean" available in supermarkets.

Tile adhesives

18.191 The quality tests for the approved tile adhesive shall be in accordance with **BS EN 12004-1**. Where cementitious tile adhesive is specified, the quality test for tensile strength shall be in accordance with **BS EN 12004-2**.

18.191A* Proprietary tile adhesive shall conform to the following standards:

Tensile Adhesion Bond Strength 28 days	>1.0 N/mm2
Tensile Adhesion Bond Strength After water immersion, 28 days	>1.0 N/mm2
Tensile Adhesion Bond Strength After heat ageing, 28 days	>1.0 N/mm2
Tensile Adhesion Strength After Freeze-Thraw Cycle	>1.0 N/mm2
Open Time @ 25 °C	Up to 30 mins
Slip Resistance	<0.5 mm

18.191B* All plasters shall be cement based, ready-mixed and pre-packed. Proprietary Tile Adhesive performance shall comply with EN 12004 Class C2TE (S1), tile grout performance shall comply with EN 13888 and shall **only** be mixed with water by machine / Mechanical mixer for a required time before application in accordance with manufacturer's specification.

Proprietary Tile Adhesive
The material shall be complied with the listed Standards:
European Norm: EN 12004 : 2001 Class C2TE (S1), EN 12002
British Standard: BS 5980 : 1980 Type 1 Class AA

Adhesion to concrete (EN 1348 : 1999) (JC/T 547 : 2004)	
Initial adhesion strength	1.9 N/mm^2
Adhesion strength after heat aging	1.8 N/mm^2

Adhesion strength after water immersion	1.6 N/mm^2
Adhesion strength after freeze-thaw cycles	2.0N/mm^2
Open time (EN 1346 : 1999)	30 min with > 1N/mm^2 adhesive strength
Slip resistance (EN 1308 : 1999)	< 0.5mm
Deformability (EN 12002 : 2002)	S1 deformable

18.191C* The specification of the external wall tiles should be as follows:

Specification	**Test**	**Standard**	**Result**
Length and width	ISO 10545-2	Deviation less than 0.5%	Meets the standard
Thickness	ISO 10545-2	Deviation less than 5%	Meets the standard
Water Absorption	ISO 10545-3	Less than 0.5%	>0.5%
Breaking Strength	ISO 10545-4	Greater than 1300N	>2000N
Modulus of Rupture	ISO 10545-4	Minimum 35MPA	Meets the standard.
Abrasive Resistance	ISO 10545-6	Maximum 175mm3	Meets the standard.
Chemical Resistance	ISO 10545-13		Class A
Stain Resistance	ISO 10545-14		Class 5

Tile grouting **18.192** The quality tests for tile grouting shall be as follows:

Test Items	Test Method	Acceptance Standards	Remarks
1. *Linear Shrinkage	ANSI A–108/A118/ A136.1-2011	1 day shrinkage < 0.1% 7 days shrinkage < 0.2%	Cast and store grout specimens at 21° - 25°C, 45 - 55% R.H.
2. *Water Absorption	ANSI A108/A13601-2011	From 50% R.H. to immersion < 5% From immersion to dry < 7%	Determine water absorption from 50% R.H. to immersion and from immersion to dry.
3. *Characteristics of cementations adhesive	**BS EN 12004-2**	≥=0.5N/mm^2	cl. 8.3.3.2 initial tensile adhesion strength cl. 8.3.3.3 Tensile adhesion strength after water immersion
	BS EN 12004-2	≥=0.5N/mm^2	Open time: Tensile adhesion strength
4. *Resistance to Mould Growth	To be decided by the SO	No sign or evidence of mould growth on tile grout.	3 mm thick tile grout is applied over biscuit side of test piece tile and the assembly be placed in Petri dishes for incubation at 29° ± 1°C for 24 hrs after addition of potato dextrose agar. Aspergillus niger is inoculated into the grout. The whole assemble is incubated for 14 days at 29° ± 1°C.

Note: For the tests marked with '*', test certificates or reports shall be issued by an accredited laboratory not more than 3 years ago.

Tile grouting **18.192A***

Compressive Strength Dry Storage / Freeze-thaw Cycles @ 28 days [N/mm2]	5 [minimum] 35 [maximum]
1Resistance to Abrasion [mm3]	<1000
Flexural Strength Dry Storage / Freeze @ 28 days [N/mm2]	≥ 28
Water Absorption [g] After 30 mins After 240 mins	 ≤fte ≤fte
Shrinkage @28days [mm/m]	≤mm/

Tile joints shall be pointed with a proprietary colour grout strictly in accordance with the manufacturer's instructions. The tile grout performance shall comply with ANSI A118.6 and EN 13888 as follows :

- The tile grout should be polymer modified, waterproof, mould resistant, cementitious tile grout.
- The pigment used should be inorganic pigment to prevent decolorization.
- The tile grout should comply to ANSI A118.6 and EN 13888 Class CG2.
- The tile grout should be free from mould growth in accordance to BS 5980.
- The linear shrinkage should be less than 0.1% for 24 hours and less than 0.2% for 7 days in accordance to ANSI A118.6.
- The water absorption rate should be less than 4% for 50% relative humidity and less than 6% for immersion to dry in accordance to ANSI A118.6.
- The 14 days tensile adhesive strength should be greater than 1500 N in accordance to BS 5980.
- The abrasion resistance should be less than 600 mm3 in accordance to BS EN

12808 Part 2.
- The compressive strength should be greater than 20 N/mm2 in accordance to BS EN 12808 Part 3.
- The flexural strength should be greater than 4 N/mm2 in accordance to BS EN 12808 Part 3.
- The shrinkage should be less than 1.5 mm/m in accordance to BS EN 12808 Part 4.
- The water absorption rate should be less than 0.4 g and 0.7 g respectively for 30 minutes and 240 minutes in contact with water in accordance to BS EN 12808 Part 5.
-

SEALING UP VOIDS WHERE PIPES PASS THROUGH FIRE RATED WALLS AND FLOORS

Fire separation seal	**18.204**	Sealing system shall be applied as specified in Clause 19.18 to properly seal up the voids formed where pipes, ducts, cables and wires, etc. pass through fire rated walls or floors.
EPDM all weather athletic Sport Surfacing	**18.205***	The EPDM all-weather athletic sport surface shall be a seamless cast in-situ Full Polyurethane system as recognized by I.A.A.F., which shall be formed in three layers and consists of an impermeable premix-machine paved-in place polyurethane-bound, with central polyurethane micro-foam layer and top coat of polyurethane and embedded EPDM rubber granules. The athletic surface shall be not less than 15mm thick, made of 1 – 4mm SBR rubber granules bedded in two component polyurethane. The EPDM all-weather athletic sport surface shall conform to the requirement of "I.A.A.F. Performance Specification for Synthetic Surfaced Athletic Tracks (Outdoor)". The entire system shall be resistant to weather, ultra-violet light colour-fading and non-toxic regardless of the colour. Materials containing TDI, Chlorinated Hydrocarbon, heavy metals and other toxic materials harmful to health and environment shall not be permitted. 1. Performance Standard The EPDM all-weather athletic sport surface shall exhibit the following minimum performance standards as per "I.A.A.F. Performance Specification for Synthetic Surfaced Athletic Tracks (Outdoor)". System: Full Polyurethane Thickness: Min. 15mm Force Reduction %: Average 43% Vertical Deformation: Average 2.26mm Friction: Average 0.65 Tensile Test: Average 0.53 Mpa Elongation at Break: 60%
Tile Nosings	**18.206***	150 x 75 x 12 mm shall be supplied by a Supplier and shall be laid in accordance with the laying specifications at the Contractor's expense. Approved coloured grooved vitreous non slip nosing tiles are to be bedded, jointed and pointed in coloured cement mortar to treads of stairs finished with mosaic tiles, washed granolithic, cement sand plastering, vinyl sheets.
Polystyrene Insulation to Walls and Ceilings	**18.207***	The polystyrene insulation boarding is to be non-inflammable.
Fire Rated Enclosure Board	**18.208***	The fire rated enclosure board as shown in the drawings shall comply with the statutory requirements. The fire rated enclosure board shall be proved capable of resisting the action of fire when tested in accordance with BS 476: to the specified period of time.

Tactile Warning Strips	**18.209***	The tactile warning strip/tile shall be installed at landings and at bottom and top ends of a ramp/staircase as indicated on drawings. The ribs shall be laid parallel to the ramp/stair edge in accordance to the design intent.
Liquid Waterproofing Membrane	**18.210***	Plant rooms accommodating pipeworks carrying water e.g. A/C plantroom, fire service room, etc. shall be finished with liquid waterproofing membrane including 300mm high upturn at wall/floor junction and dressing around pipe penetrations.
Floating Concrete Floor	**18.211***	The Isolation pads shall be 50 x 50 x 50 pre-compressed molded fiberglass isolation pads, individually coated with a flexible electromeric membrane, designed to be capable of withstanding an imposed load of 100 PST within 18.5% deflection. Isolation pads shall be spaced at maximum 300 mm centers both ways laid on the waterproofing membrane over the concrete slab. The infills shall be low density, fiberglass absorption material, with an HRC rating of "7" shall be bonded to the isolation pads, and shall cover a minimum of 95% of the area between the isolation pads. The concrete pouring forms shall be 12mm thick exterior grade plygo assembled with galvanized steel junction plates with screws, and covered by two layers of polyvinyl sheets and joint tapes. The perimeter isolation shall be 16mm thick closed cell expanded polyethylene perimeter isolation board, and perimeter polysulphide caulking to be applied on the top of the isolation board after curing of the concrete slab.

GENERAL SPECIFICATION
FOR
BUILDING

SECTION 19

SANITARY APPLIANCES

SECTION 19
SANITARY APPLIANCES

Generally **19.1** All plumbing work shall be in compliance with the Water Authority's requirements and Waterworks Regulations.

The water usage for all products shall meet the Grade 1 water efficiency rating for Showers for Bathing, Water Taps, Water Closets, Urinal Equipment and Flow Controllers of the Voluntary Water Efficiency Labelling Scheme (WELS) of the Water Supplies Department, unless otherwise specified, or product with other water efficiency ratings is required to meet particular functional purpose as approved by the SO / as specified in the Particular Specification.

All products shall not contain heavy metals like lead, cadmium, mercury or hexavalent chromium and organically bound halogens.

Scope of Work **19.2** This Section covers all sanitary appliances supplied by the Contractor and the installation of all sanitary appliances, including those supplied by the Employer.

This part of the GS shall be read in conjunction with the **General Specification for Building Services Installation in Government Buildings of the Hong Kong Special Administrative Region** published by the Architectural Services Department, HKSAR.

Generally **19.3** ~~Inspect pipes and fittings inside and out before fixing. Reject any which are defective.~~

~~Certain standard sanitary appliances may be supplied by the Employer, as scheduled on the drawings. These may include brackets, waste fittings, traps, taps, valves, chains and plugs & all fittings which relate to fixtures.~~

~~Provide all other sanitary appliances as specified. Submit samples of all sanitary fittings for approval.~~

(a) All sanitary fittings unless specified otherwise shall be white, from an approved manufacturer, generally ensuite and complete with all necessary fittings.

(b) Wastes, outlets and overflows to **BS EN 274,** exposed surfaces shall be either chromium plated or other non-chromium plated alternatives subject to approval by the SO. Cr-Ni coating shall comply with **BS EN 248**.

(c) Taps and combination tap assemblies to **BS EN 200,** exposed surfaces shall be either chromium plated or other non-chromium plated alternatives subject to approval by the SO. Cr-Ni coating shall comply with **BS EN 248**.

19.3A* Sanitary Assemblies shall include all appropriate components and accessories deemed necessary for the activities such assemblies are intended for. All fittings shall be of sound quality, suitable for the works and sourced from a co-ordinated range.

All sanitary fittings shall comply with the Waterworks Ordinance and Regulations. If the sanitary fittings have been accepted by the Water Supplies Department (WSD) for use in the plumbing system, requirements and conditions stipulated in WSD's acceptance letters for acceptance on the construction, quality, durability, efficiency, etc. of the fittings shall be fully adhered to and without modification.

All fittings shall be designed and constructed to the requirements of **HTM 64** and comply with the recommendations of **HTM 2040**.

All accessories and fixings not included in the descriptions of the fittings shall be provided as parts of each fitting as recommended by the manufacturers. These shall include but not limited to brackets, waste fittings, traps, taps, valves, chains and plugs, etc. Unless otherwise stated all sanitary fittings are in white vitreous china. Seats and covers to water closet shall be in contrasting colours with the background wall and floor finishes against which it is being viewed.

Components and accessories shall not sustain the growth of bacteria. Components shall be easy to clean. There shall be no inaccessible recesses, rough surfaces or projections, sharp edges etc. which may retain dirt, snag cleaner's hands or equipment, or be difficult to reach. Components shall be sealed at junction with floor and walls with a suitable sealant.

All appliances shall be capable of accepting live loadings in use. A load of 150kg shall be sustained by the assembly. Back panels or spreader devices shall be used when fixing basins, sinks or urinals to ensure a firm fixing free from indentation from brackets or fixing plates. Where appliances are mounted on fiat surfaces of floors or walls a waterproof seal shall be made at contact points.

Water shall be supplied via a fixed, swivelling or flexible outlet that shall be concealed. The final discharge shall be through a plain or aerated nozzle or a spray. Combination fittings shall be provided with annular flow outlet to avoid risk of scalding.

Baths **19.4** Baths shall be vitreous enamelled sheet steel to **BS 1390** with adjustable feet for 75 mm seal trap holed at end for and including combined waste and overflow to **BS EN 274** complete with plug and chain if applicable and chromium plated brass taps to **BS EN 200**.

19.4A* Baby bathtubs shall be custom designed in cast epoxy resin, approx. 1200x750mm and 410mm high or other size to accommodate removable plastic bath tub as provided by the users, with no tap holes, complete with thermostatic mixing control and shower hose.

Shower trays **19.5A*** (a) Shower tray

Shower trays shall be prefabricated to **BS EN 251** and **BS EN 14527+A1** made from glazed ceramic or resin-stone with solid surface. Any solid surface shall comply with **BS EN ISO 19712-1, BS EN ISO 19712-2 & BS EN ISO 19712-3.**

All shower cubicles shall be provided with proprietary shower trays (min. 900 x 900mm), shower curtain rails, wall-mounted and concealed thermostatic shower mixer valve with shrouded rotating top(s) for control of temperature and volume, fixed showier head or handset with flexible hose on sliding rail kit and all necessary supply fittings. Thermostatic mixer valve shall be designed to comply with **BS 7942** and have fail-safe temperature control (automatic shutdown whenever the cold water supply fails), preset and be locked to provide a blended water temperature not exceeding 41 °C at point of discharge, unaffected by changes in water pressure and approved under "**BuildCert TMV3**" scheme.

Shower heads shall comply with **BS 6340-4**. All shower mixer valves shall be of Grade 1 water efficiency rating under the Voluntary Water Efficiency Labelling Scheme (**WELS**) of Water Supplies Department (WSD).

(b) Patient showers

Patient showers shall consist of proprietary true-level access non-slip aluminium shower grille system in nylon-coated finish on top of fibreglass trays with top access chrome-plated waste and plastic resealing trap assembly and equipped with proprietary concealed shower valve of robust construction, lever operated in single sequential operation from off through cold to warm and built-in **TMV3** thermostatic valve, fixed shower head, foldable shower seat with back support and shower curtain.

(c) Shower grilles

The shower grilles shall provide a minimum of 74% foot contact area yet disperse water quickly without messy puddles. The shower grilles shall be divided into two half section: making them easier to remove and replace for cleaning. The system and its accessories shall comply with tests to the load bearing parameters laid down in **BS 4592-1** and shall be able to withstand loads of up to 250kg without detriment to performance. Shower curtain rail shall be proprietary product specially designed with safety devices to collapse with a maximum load of 40kg is applied onto the shower curtain rail, and shall be subsequently reset easily. Shower seat shall be made of ABS with stainless steel folding bracket and assemblies to withstand a minimum seat load of 150kg.

(d) Anti-slip ceramic shower tray

Anti-slip ceramic shower trays shall be provided with top access waste and resealing trap assembly completed with removable dust cover and slotted grid and equipped with proprietary concealed shower valve of robust construction, lever operated in single sequential operation from off through cold to warm and built-in **TMV3** thermostatic valve, shower handset with holder, sliding rail and flexible hose.

Large size shower gel tray shall be proprietary product in the form of a corner tray made of grade 316 stainless steel. Each shower or changing cubicle shall be individually provided with a single clothes hook in stainless steel satin finish.

(e) Wall mounted shower panel system

Wall mounted shower panel system for assisted bath/shower shall be proprietary product incorporating thermostatic mixing control, automatic pressure balance control, adjustable temperature control and display, patient shower with trigger control handle, integrated flush tank and built-in disinfection system. The disinfection unit shall have adjustable disinfectant mixer valve and disinfection handle. A wall mounted stainless steel cone-shaped flushing sink with WC function and P-trap outlet shall be provided underneath the shower panel.

Shower fittings **19.6A*** Shower fittings shall be Grade 1 water efficiency rating under the Water Efficiency Labelling Scheme on Showers for Bathing commissioned by the Water Supplies Department (WSD) of the HKSAR.

Shower fittings shall be either chromium plated brass or other non-chromium plated alternatives, with approved easy clean valve, thermostatic valve or as specified fitted with one of the following:

(f) Concealed or exposed shower fittings for lever with flexible hose 1500 to 1800 mm long c/w chrome plated sliding bar and head.

(g) Time-delayed control for adjust 15 – 30 seconds cold or mixer.

(h) Self-cleansing swivel-jointed rose with an adjustable spray.

The nominal flow rate of the shower shall be less than or equal to 9 L/min. Cr-Ni coating shall comply with **BS EN 248**.

Thermostatic mixer valve shall be designed to comply with **BS 7942** and have fail-safe temperature control (automatic shutdown whenever the cold-water supply fails), preset and be locked to provide a blended water temperature not exceeding 41°C at point of discharge, unaffected by changes in water pressure and approved under "**BuildCert TMV3**" scheme. Shower heads shall comply with **BS 6340-4**. All shower mixer valves shall be of Grade 1 water efficiency rating under the Mandatory Water Efficiency Labelling Scheme (**WELS**) of Water Supplies Department (WSD).

Shower mixers shall be concealed type single lever mixer completed with hot and cold water connection with fixed shower head.

For accessible shower compartment, the shower head should be complied with the respective barrier free requirement.

Shower grilles **19.6B*** Shower grilles shall provide a minimum of 74% foot contact area yet disperse water quickly without messy puddles. The shower grilles shall be divided into two half section: making them easier to remove and replace for cleaning. The system and its accessories shall comply with tests to the load bearing parameters laid down in **BS 4592-1** and shall be able to withstand loads of up to 250kg without detriment to performance.

Patient showers shall consist of proprietary true-level access non-slip aluminum shower grille system in nylon-coated finish on top of fibreglass trays with top access chrome-plated waste and plastic resealing trap assembly and equipped with proprietary concealed shower valve of robust construction, lever operated in single sequential operation from off through cold to warm and built-in **TMV3** thermostatic valve, fixed shower head, foldable shower seat with back support and shower curtain.

Taps **19.7A*** (a) Taps shall be:

(i) Operating pressure for sensor tap shall be between 0.3 – 10 bar. Max. water temp. 80°C. Aerator. Self-cleaning. Turn-off control pre-set 0 – 3 seconds.

(ii) Sensor mixer or cold.

(iii) Self-closing tap for time delay function.

(iv) Bib tap.

The nominal flow rate shall be less than or equal to 2 L/min for non-mixing type water taps and shall be less than or equal to 5 L/min for mixing type water taps. Alternatively, mixing type water taps with nominal flow rate less than 7 L/min to match the minimum flow of connected appliance shall also be accepted subject to approval by the SO.

All water taps shall be Grade 1 water efficiency rating under the Mandatory Water Efficiency Labelling Scheme (**WELS**) of Water Supplies Department (WSD). All sensor taps shall have preset time automatic sterilization cleansing feature or hygiene rinse function to facilitate cleansing and sterilization during T&C and future maintenance to prevent Legionella. Remote controls to change/adjust the settings of the sensor taps, program the hygiene rinse function, etc. shall be provided by the Contractor and handover to the users upon completion.

(b) Wall mounted sensor tap

Wall mounted sensor tap with cold water supply only shall be provided for each wash hand basin in public toilets and staff toilets (or as specified in the Employer ’s Requirements). Except for the above, wall mounted sensor tap with built-in or integrated **TMV3** thermostatic mixing valve shall be provided for each wash hand basin inside toilets. Spout length shall be carefully selected to match with the basin to minimize water splashing from the faucet.

(c) Basin mounted sensor tap

Basin mounted sensor tap with cold water supply only shall be provided for accessible toilets.

(d) Infra-red sensor operated water taps and urinals

Use of infra-red sensor operated water taps and urinals. Water taps shall be of water efficiency of Grade 2 or above, of which 50% to be Grade 1 under the Mandatory Use of Designated Products registered under Water Efficiency Labelling Scheme on Water Taps commissioned by the WSD. Urinals shall have Water Efficiency Grade 1 under the Mandatory Use of Designated Products registered under Water Efficiency Labelling Scheme commissioned by the Water Supplies Department (WSD) of the HKSAR.

Ceramic wash basins **19.8** Ceramic wash basins shall be to **BS 1188** and shall be made from vitreous china to **BS 3402** of the following types as specified:

(a) Under counter basin with overflow.
(b) Wall hung basin with or without pedestal as specified.
(c) Semi-recessed basin with or without overflow as specified.
(d) Counter top basin with or without overflow as specified.

19.8(1)* Wash hand basin shall have a smooth form and easily-cleaned surfaces. Overflows shall not be provided for infection control reasons. Unless otherwise specified, there shall be no tap holes and no chainstay holes.

Appropriate combinations of basins and taps shall be selected for medical/nursing procedures, personal washing seated users and hand rising. Whenever sensor tap is required in this specification, it shall be A/C operated with transformer supplied by the same manufacturer of the sensor tap.

Solid surfacing wash basins **19.8A** Solid surfacing wash basin shall comply with **BS ISO 19712-1, BS ISO 19712-2 & BS ISO 19712-3** with drain, with or without overflow as specified and to size and configuration shown on the drawings.

Kitchen sinks **19.9** Sinks shall be to **BS EN 695** and **BS EN 13310+A1** and to the size and configuration shown on the drawings with overflow and sound deadening pads under the sink and drainers.

Sinks shall be provided with an effective means of attaching a bonding conductor which shall be accessible to the electrician after the sink has been installed.

Pantry Sink **19.9(1)*** (a) Shall be integral double sink of the same solid surfacing material as the bench top. The size of sink bowls shall be min. 400x500x300mm deep to suit the operational need and incorporated with unslotted waste fittings with plastic bottle trap.

(b) Deck mounted single lever thermostatic mixer shall be provided for the sink unit.

Stainless steel sinks **19.9A** All sinks, shall be fabricated of not less than 1.6 mm polished stainless steel except hand basins of at least 1.2 mm, with stainless steel grade 316, and of the size and design as specified.

Solid surfacing sinks **19.9B** Solid surface shall comply with **BS ISO 19712-1**, **BS ISO 19712-2 & BS EN ISO 19712-3.**

Cleaner's sinks **19.10** Fireclay cleaner's sink shall conform to **BS 1206** in white colour. Fireclay with a 38 mm hole for chrome plated waste. To be provided with or without overflow as specified.

19.10A* (a) Cleaner's sink shall be made of heavy-duty solid cast white vitreous china of size approx. 510x380mm and 230mm deep, fitted with stainless steel bucket grating and rubber bumper, wall mounted with stainless steel legs screwed to wall bearers, with chrome plated unslotted strainer waste and plastic resealing bottle trap.

(b) Wall mounted lever action bib taps with separate manual control of cold and hot water shall be provided for the sink unit.

(c) Stainless steel wall panel shall be applied to protect from water finishes from back splash of water.

Close-coupled suits, one piece and independent W.C.s

19.11(1)*

(a) All water closets shall be manufactured in white vitreous china with integral trap and horizontal outlet to **BS EN 997 Class 2**. High impact plastic ring seat and cover shall conform to **BS 1254** and fixed with soft closing stainless steel hinges. All exposed surfaces of water closets shall be smooth, easy to clean and maintain, and durable.

All water closets shall be proprietary products and wall-hung rimless wash-down water closet pans of approximately 400mm high with horizontal outlet and back inlet for concealed cistern and services, completed with all fittings and flushbend for sensor-operated flush system with manual overriding push button. It shall be appropriate for salt water use.

(b) Accessible water closet shall be of raised height of approximately 450mm high (measured to the top of toilet seat to comply with the Barrier Free Access requirement), fully shrouded, back-to-panel rimless wash down water closet pan with horizontal outlet and back inlet for concealed cistern and services, completed with all fittings and flushbend for sensor-operated flush system with manual overriding push button. Back rest with cushion and wall hung rimless WC pan completed with spacer box shall achieve an overall 750mm projection.

(c) Proprietary electronic infra-red sensor flush system with manual overriding push button shall be concealed with satin stainless steel face plate, AC powered with waterproof IP65 transformer, adjustable flush volume and connected with hydraulic operated flush valve or concealed cisterns by cable flush valve mechanism. Satin finish stainless steel or aluminium instruction plate shall be provided for each sensor flush system with manual override button.

(d) Child water closet shall be of lower height of approximately 350mm high, fully shrouded, back-to-panel rimless wash down water closet pan with horizontal outlet and back inlet for concealed cistern and services, completed with all fittings and flushbend for sensor-operated flush system with manual overriding push button.

Squat type W.C

19.11A

Vitreous china Squat type W.C. pans to Singapore Standard **SS 379**.

Flushing cistern

19.11B

The toilet should be dual-flush type, and the maximum flushing-water volume should be less than or equal to 3.2 L per reduced flush and less than or equal to 4.8 L per full flush**,** complete with flushing apparatus, discharge pipe, ball valve and overflow, of one of the following types as specified:

(a) Low level plastic.

(b) High level plastic.

(c) Low level vitreous china.

(d) Close coupled vitreous china.

Sensor valve where specified for automatic flushing shall be copper alloy bronze (gunmetal) or other materials approved by the SO. Operating pressure shall be 0.5 – 10 bar rinse. Time-off control approx. 10 seconds and remote adjust from 1.5 – 30 seconds. The sensor shall either be operated by 6 V Lithium battery or 220 V AC power step down to 6 V.

Sensor fittings shall be suitable for use in salt water application.

19.11B(1)*

All water closets to be of water efficient type (i.e. sensor operated with press type dual flush function, of capacity less than 3 litres for reduced flush and less than 6 litres for full flush, with mechanical or electronic flush control mechanism, etc.) unless there are genuine operational or technical needs for not doing so.

Proprietary electronic infra-red sensor flush system with manual overriding push

button shall be concealed with satin stainless steel face plate, AC powered with waterproof IP65 transformer, adjustable flush volume and connected with hydraulic operated flush valve or concealed cisterns by cable flush valve mechanism. Satin finish stainless steel or aluminium instruction plate shall be provided for each sensor flush system with manual override button.

Space saving slim type dual flush cistern tank shall be incorporated for accessible toilets.

Urinals **19.12** Wall hung urinals shall be to **BS EN 13407+A1**. Vitreous china bowl type to **BS 5520** with 50 mm diameter of waste outlet, complete with vitreous china automatic flushing cistern to **BS 1876** or automatic flushing sensor valve, chromium plated flush pipes and spreaders to suit the number of appliances. The flush volume of urinal and trough urinal shall be less than or equal to 1.5 L for every basin or stall, and every 0.5 m of a trough urinal respectively.

Sensor valve shall be copper alloy bronze (gunmetal) or other materials approved by the SO. Operating pressure shall be 0.3 – 10 bar rinse. Time-off control approx. 9 seconds and remote adjust from 7 - 22 seconds. The sensor shall either be operated by 6 V Lithium battery or 22 0V AC power step down to 6 V.

Sensor fittings shall be suitable for use in salt water application.

19.12A* Urinal shall be manufactured in white vitreous china to comply with **BS 3402**, approx. 400mm wide. All service connections to be completely concealed, with plastic 'P' trap, back inlet spreader, plastic domed waste and concealing fixing.

Urinal flushing valves shall be provided and completed with proprietary pipes, fittings and accessories of the same manufacturer. The flushing valves shall have automatic self-adapting sensor technology and hygienic rinse or pre-rinse function. Wall-mounted privacy screen panels shall be provided for multiple urinals. Vent pipes leading to the roof top shall be provided to all urinals.

All urinal equipment shall be registered as Grade 1 under the Mandatory Water Efficiency Labelling Scheme (**WELS**) of WSD unless there are genuine operational or technical need for not doing so.

(a) Panel mounted urinal

Panel mounted urinal shall be manufactured in white vitreous china with concealed services conforming to **BS EN 13407**. Proprietary electronic sensor flushing valves to **BS EN 15091** shall be panel mounted with satin stainless steel face plate, AC power with waterproof IP65 transformer and suitable for use with rim or rimless flushing urinals.

(b) Accessible urinal

Accessible urinal shall be provided with H-type breast bar at a height of 1200mm above the finished floor level for use by persons with ambulant disabilities.

H-type breast bar shall be proprietary product made of aluminum in polyester coated finish with non-slip texture to avoid cold grab and completed with non-conductive concealed fixings for wall mounting.

H-type breast bar shall be of not less than 32mm and not more than 400mm in external diameter, 600mm in length for the vertical bars and 900mm in length for the horizontal bar and projecting 300mm from finished wall surface.

Glazed ceramic slab urinal **19.13** Glazed ceramic slab urinal shall be fireclay or vitreous china in white colour to the size and configuration shown on the drawings and comply with **Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations 16**. The length of urinal slab shall be as approved by the SO.

Fireclay and vitreous china are defined in Clauses A2.2 and A2.1 of Annex A, **BS EN 14516+A1** respectively. Vitreous china shall be to **BS 3402**.

Stainless steel slab urinal **19.14** Stainless steel slab urinal shall be to **BS 4880-1** grade 316 as specified in Clause 17.9, 1.5 to 1.6 mm thick, with satin finish to the size configuration shown on the drawing with sound deadening pads behind the slab, and comply with **Building (Standards of Sanitary Fitments, Plumbing, Drainage Works and Latrines) Regulations 16**. Custom made size slab urinal may be straight, L-shaped or U-shaped as shown on the drawings with joints and length of the slab as approved by the SO.

Traps **19.16** Traps shall have 80 mm seal, unless otherwise specified.

Cast iron traps shall be to **BS EN 274**.

Plastic waste traps shall be to **BS EN 274-1**, **274-2 and BS EN 274-3** or to be of an approved proprietary brand.

19.16A* (a) Self-resealing bottle traps

Resealing bottle traps shall ensure retention of adequate water seal even under extreme symphonic conditions by simple non-mechanical action and eliminates the need for secondary ventilation. The resealing bottle trap shall be able to ventilate by drawing air through the inlet of the trap and through water seal.

(b) Anti-syphonic trap

The anti-syphonic trap shall be able to ventilate by drawing air through a non-return valve. The anti-syphonic trap can draw air through the valve neutralizes symphonic pressure before it reaches the seal of the trap and therefore provides the equivalent of a ventilated system without the installation of costly and unsightly ventilation pipes.

The trap can be rigorously tested and will not unseal, even under the most abnormal conditions. The trap should continue to be effective irrespective of the distance between the appliance and the soil pipe. Whenever symphonic conditions develop, the negative pressure causes the valve to rise thereby allowing air to be drawn into the discharge pipe thus neutralizing the pressure. Simultaneously, with the cessation of the symphonic action, the valve closes to make the anti-syphonic trap air and watertight. The trap shall allow the air to be drawn through the valve and not through the water seal and eliminate gurgling. During discharge, air is drawn into the system through the valve, thereby neutralizing symphonic action and ensuring a quieter flow.

Silicone sealant **19.17** Silicone sealants shall be to **BS EN ISO 11600+A1**.

Type F Class 25 in white colour or to match sanitary fixtures and to **BS EN ISO 846**.

All sealants shall comply with VOC content limit stipulated in the **Air Pollutions Control (VOC) Regulation of Hong Kong** and shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride). The products shall contain no more than 0.01% by wet weight of formaldehyde and no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

Fixing W.C. pans **19.23** Fix W.C. pans as follows:

(a) Pedestal type

(i) ~~Bed W.C. pans on concrete floors in other non-hardening compound. If cement mortar is used for bedding, it shall be not richer than 1:6, and a thin layer shall be applied only to that part of~~

~~the pedestal which is in contact with the floor.~~ Fix with No. 14 SG round-headed brass screws 70 mm long with domed plastic inserts in colour to match to fixture.

(ii) Joint W.C. pans to soil or drain pipes with approved PVC W.C. pan connectors to **BS 5627** or other approved type.

~~(b) Squatting type~~

~~(i) Bed W.C. pans in concrete floors in cement and sand mortar 1:3 and joint to soil or drain pipes in similar mortar.~~

~~(c) Wall hung type~~

~~(i) Fix wall hung type WC pans to load bearing walls or support frame by non-ferrous fixing bolts. Water tight seal between the walls and the edge of the W.C. pans shall be made by appropriate sealant.~~

Divider for urinal **19.26*** Divider for urinal shall be in white vitreous china to **BS 3402** Specification for quality of vitreous china sanitary appliance or other similar materials (e.g. painted or patterned safety glass), fixing with screws and hanger.

Disposal units and sinks **19.27*** (a) Disposal units and sinks shall be manufactured in grade 316 stainless steel with satin finish to **BS EN 10088-2** with minimum thickness of 1.5mm or 1.2mm thick where press formed. Underside shall be sound-deadened with smooth, impermeable, easily cleaned material and underlined with stainless steel.

(b) Disposal units and sluice sink

Hospital pattern disposal units shall have stainless steel plain top incorporating a sink and a hopper (with left or right handed versions) of overall dimension 1600x600mm and shall be provided for the disposal of solid and liquid waste in connection with clinical procedures.

Disposal unit shall have no tap holes, no overflow and upstand, edges rimmed and turned down. It shall be wall/panel mounted with stainless steel brackets, fixings with earthing terminal and all associated fittings supplied by the same manufacturer. The stainless steel slop hopper shall have back inlet for plastic flush pipe connection with lever operated concealed type cistern suitable for high/low level installation and compatible with the hopper, chrome plated unslotted waste fittings with plastic P-trap outlet.

Wall mounted lever action bib taps in hospital pattern with separate manual control of cold and hot water shall be provided for the sink unit.

Plaster sink **19.28*** (a) Stainless steel plaster sink unit with integral plain top work surface (with left or right handed versions) shall have no tap holes, no overflow and upstand, edges rimmed and turned down and of overall dimension 1200x600mm. The rectangular sink bowl shall incorporate with a round sump to accommodate a partially perforated stainless steel basket strainer and covered by a close-fitting stainless steel cover with recessed handle to prevent plaster from blocking the drain. It shall be wall/panel mounted with stainless steel brackets, fixings with earthing terminal and all associated fittings supplied by the same manufacturer.

(b) Wall mounted lever action bib taps in hospital pattern with separate manual control of cold and hot water shall be provided for the sink unit.

Inset sinks **19.29*** Inset sinks in clinical areas

(a) Shall be manufactured in grade 304 stainless steel with satin finish, inset sink with single bowl of overall dimension 1200x600mm or double bowl of overall dimension 1800x600mm integral, with sink top with or without drainer (with left or right handed versions), with no tap hole and no

overflow. The sink bowls shall be of adequate depth to suit the operational need and incorporated with unslotted waste fittings with plastic bottle trap.

(b) Wall mounted lever action bib taps in hospital pattern with separate manual control of cold and hot w'ater shall be provided for each sink unit.

Surgical scrub stations **19.30*** Type I scrub stations shall be proprietary products consisting of washing compartments completed with built-in sensor operated thermostatic mixer taps and knee-operated soap dispensers. Scrub station shall be with either one, two or three units, as specified in the Function Brief or Room Data Sheets. Washing compartment shall be continuous even if a multiple-station unit is specified. Divider screens made of sheet acrylic shall be provided to divide into 2 or 3 station units for reducing splash and aerosol contamination between adjacent units. The bottom of the compartment shall be formed to reduce splashing and to flush soil away from the user. The underside of the compartment shall be sound-deadened. Each unit shall be completed with all components necessary to obtain a complete working station, ready for installation and connection to building services. Water temperature shall be automatically maintained by thermostatically controlled mixing valve.

Type II scrub stations shall be proprietary hospital pattern scrub-up trough completed with wall mounted thermostatic sensor tap and proprietary automatic soap dispenser for each washing compartment.

(a) Hospital pattern scrub-up trough shall be manufactured in grade 304 stainless steel of min. 1.5mm thick with satin finish to **BS EN 10088-2**, available in three sizes for single, double or triple compartment (with divider screens made of sheet acrylic in-between), shaped to avoid splashing, with all internal comers radiused and shrouded bottom outlet with strainer waste, plastic resealing bottle trap and stainless steel trap cover at one end (with left or right handed versions) to suit the room layout. It shall be wall/panel mounted with stainless steel brackets for use with concealed services, fixings with earthing terminal and all associated fittings supplied by the same manufacturer. All exposed surfaces of scrub-up trough shall be smooth, no sharp edges, easy to clean and maintain, and durable.

(b) Panel mounted sensor tap for surgical scrub-up station shall be concealed type with **TMV3** approved thermostatic digital mixing valve offering programmable maximum, minimum and default temperatures, duty flush and thermal disinfection with temperature logging and data logging capabilities; and completed with programmable software, power supply, isolators, non-return valves and filters from the same manufacturer. Panel mounted control panel shall have infrared non-touch controls for temperature adjustment and programming. Panel mounted spout shall be approximately 225mm long for easy scrubbing of hands and arms and shall have integrated sensor for activated on/off control or timed flow control.

Emergency shower and eye/face washer **19.31*** Emergency shower shall be proprietary product of deluge shower with impeller action shower head of approximately 200mm diameter and horizontal overhead supply with concealed piping, completed with stay-open full flow ball valve and flow control regulator. The deluge shower shall be able to deliver 20 gallons of water per minute (i.e. 20GPM) for 15 minutes and complied with **ANSI Z358.1**, The emergency shower shall be activated by a highly visible yellow colored powder coated aluminium triangular pull rod. Universal emergency sign shall be provided.

Eye washer shall be proprietary product of wall mounted stainless steel bowl integrated with dual aerated spray heads of ABS plastic with flip-top dust covers, integrated with automatic flow control, self-closing valve and integral supply and waste pipes. The eye washer shall be activated by a stainless steel push handle to deliver 3.6 gallons of water per minute (i.e. 3.6GPM) for 15 minutes and complied with **ANSI Z358.1**. Universal emergency sign shall be provided.

Side slot channel **19.32*** (a) Prefabricated and proprietary polymer concrete channel shall be 1% invert fall from 100mm to 260mm, with integrated stainless steel 316 edge-rail.

(b) The channel manufacturer shall provide calculation to demonstrate and

guarantee the workability of the whole system. The whole system, including channel, edge rail and slot frame shall be provided by a single manufacturer.

(c) The pre-casted surface channel shall be in 500mm/1000mm in length and completed with grade 316 stainless steel proprietary side slot cover frame, height 50/75/100 mm to form a 13mm wide continuous single inlet slot; finished on top with tiles (tiles measured separately).

(d) The surface channel system shall be equipped with side slot access panels for maintenance, which is consisting of two frames while one of the frames is removable for easy access. The whole channel system shall withstand loading class of C250 (25t) in accordance with **BS EN1433**.

The Contractor shall provide loading certificate issued by accredited laboratories under **HOKLAS** as well as a BD/ASD approved letter.

(e) Technical performance for polymer concrete channel shall be as follows:

Flexural strength:	not less than 22 N/mm^2
Compressive Strength:	not less than 90 N/mm^2
Modulus of elasticity:	Around 25 KN/mm^2
Density:	2.1 – 2.3 g/cm^2
Penetration depth of water:	0 mm
Roughness depth: approx.	25 µm
Roughness coefficient (Manning):	0.011 (average)

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 20

GLAZING

SECTION 20
GLAZING

Generally **20.1** This section is predominantly intended for glazing in doors and windows and should therefore be read in conjunction with Section 16 when curtain walls and window walls are the subject of the glazing requirement.

Ordinances, Regulations, Codes and standards **20.1A** Comply with the Ordinances, Regulations, Codes of Practice, Standards and PNAPs relevant for Curtain Walls and Glazing under Section 16 and Section 20. All Standards and Codes of Practice are to be the latest issue. If there is any conflict between the standards and codes listed, the more onerous is to apply.

Glass generally **20.2** Glass generally shall be in accordance with **BS 952-1, BS 952-2** or **ASTM C1036**.

Glass shall be from a manufacturer with quality assurance systems covering all aspects from manufacturing, testing and inspection. For each batch of glass supplied to site, submit a certificate from the glass manufacturer confirming compliance with the requirements detailed in this Specification.

Glass functioning as protective barrier shall be subjected to impact test by the glass manufacturer to satisfy Class 1 requirement in accordance with **BS EN 12600** without glass breakage. For laminated glass of different pane thickness or insulating glass unit of different types of glass panes, impact test shall be carried out on both faces unless the risk of impact is from one side only.

The thermal capacity of the window glass / curtain wall for the room provided with air conditioning system shall not exceed the heat transfer coefficient (U-value) of 1.4 W/m^2K except the school building.

The product components (including frame, glass, paint, surface treatment, etc.) shall not be formulated with the following substances or their compounds:

(a) Arsenic
(b) Cadmium
(c) Hexavalent chromium
(d) Lead
(e) Mercury
(f) Organic tin
(g) Phthalates

20.2(1)* Suitable window types with glazing shall be provided and installed to provide sufficient sound insulating quality capable of mitigating the current and anticipated noise impact within the limits under the **Noise Control Ordinance**, **HKPSG** standards. Please refer to Clause 3.1.2 & 3.1.3 of Part III of CR for the detailed performance requirements.

The thickness of glazing shall be determined by engineering practice with consideration to method of fixing, area of plane, design wind loads and noise mitigation performance. For rooms where Road Traffic Noise Exceedance β is > 10, glazing shall be Insulated Glass Unit (IGU) comprising of minimum 8mm clear heat-strengthened glass at the inner pane, with minimum 12mm air gap and laminated glass at the outer pane made of minimum 8mm clear heat-strengthened glass + 1.52mm thick PVB interlayer + 8mm clear heat-strengthened glass. Glass shall have solar control low-emissivity coating(s) on 4th surface or the necessary configuration to comply with the requirement of Overall Thermal Transfer Value (OTTV) and Residential Thermal Transfer Value (RTTV) in Clause 5.6 and

acoustic requirements in Clause 3.1.2 & 3.1.3 of Part III of CR. The thickness of single glazing for all habitable and domestic rooms shall have a minimum thickness of 6mm. All glass units shall be fabricated with autoclaved edges on all four sides. All glass substrates shall be thoroughly cleaned and dried prior to the fabrication of units. Fixing of glazed panels to the aluminium extrusions shall not be support entirely by structural sealant. The Contractor shall be responsible to submit calculations to substantiate his design to the satisfaction of the Director of Environmental Protection.

All IGU shall be proprietary made factory-sealed.

Glass shall be of anti-reflective glass with low solar heat gain, to avoid reflected glare to the surrounding buildings and environment.

Obscured glass is required for bathrooms and changing rooms.

Glazing requirements and testing specified in Section 2.0 to be complied with.

Glass used for the parapet wall, glass enclosure, partition, window and any other interior furniture shall take into account the imposed load requirement not inferior than the requirement as specified in the **PNAP-APP-110**.

The glass shall be clean cut, without significant edge faults (including feathered edges, shells or other imperfections) and free from bubbles, inclusions, cracks ripping dimples or other defects. Distortion shall be kept to an absolute minimum and no local defects producing irregular reflections shall be allowed.

Edge working of the heat-treated glass shall be flat ground with ground arris and have a frosted appearance. Corners shall be dubbed. Small shells and/or chips shall be ground out prior to toughening. Maximum chip/shell diameter shall not exceed 2mm, and there shall not be more than four randomly placed chip/shells in any single pane of glass.

Provide heat-treated glass as required by the glass product selected, design wind pressure, anticipated thermal stress, or use in a spandrel area. If heat treatments cannot meet wind loads, thicker glass shall be provided to meet the requirements of design pressures. The glass manufacturer must provide calculations that support their recommendations for their products.

Tempered & laminated glass **20.2A**

Tempered and laminated glass shall conform to the relevant safety class requirements of **BS 6262-4** and shall be determined by testing to **BS EN 12600** although tests in accordance with **ANSI Z97.1** are acceptable.

Edge quality **20.2B**

Edge quality finish for all glass, irrespective of heat treatment, is important. Heat treated glass may be rejected, and annealed glass will be rejected, if it does not conform to the following criteria:

(a) Shark teeth shall not penetrate more than half of glass thickness.

(b) Serration hackle may occur only within 150 mm of corners.

(c) Flare shall not exceed 1.0 mm as measured perpendicular to glass surface across the edge. Flare shall not occur at setting blocks.

(d) Bevel shall not exceed 1.6 mm.

(e) Flake chips may occur only within 200 mm of corners; depth shall not exceed 0.8 mm and length or diameter shall not exceed 6.0 mm.

(f) Rough chips shall not be permitted. Rough chips shall be those which

exceed any of the dimensional limits for flake chips.

(g) Shells on the face of the glass are not permitted on annealed glass and are only acceptable for heat treated glass if they were present prior to heat treatment and are covered by a glazing bead or glass stop. They are not permitted for glass that will be structurally glazed with silicone.

20.2B(1)* All edges and cuts shall be accurate, clean, sharp, square, smooth and free of burrs.

Insulating glass **20.2C** (a) Insulating glass shall have double edge seals. Primary seal shall be extruded polyisobutylene continuously bonded to glass surfaces and desiccant filled metal spacer, including corners. Minimum width of primary seal shall be 3.0 mm. Secondary seal shall be a 2 part neutral cure structural sealant. Secondary seal shall completely cover spacer with no gaps or voids, and shall be continuously bonded to both plates of glass. Tin side of the glass panes shall be located on the outermost surfaces of insulating glass units for future surface stress measurement. Submit the following quality documents produced by the glass manufacturer:

(i) Details of insulating glass units, including construction details, primary and secondary seals, gas filling, corner treatment, nature of spacers, evacuation and assembly process provided by the glass manufacturer.

(ii) Test report/certificate indicating compliance with **ASTM E2190** with respect to specification and seal durability for insulating glass units.

(b) Where non-pyrolytic Low-E coatings are used, edge deletion of the coating is required unless specifically stated as not being required by the glass manufacturer.

20.2C(1)* Vision panels shall be Insulated Glass Units (IGU) comprising of minimum 10mm clear heat-strengthened glass with low-E coating inside, air gap of appropriate thickness and laminated glass made of minimum 8mm clear heat-strengthened glass + 1.52mm thick PVB interlayer + 8mm clear heat-strengthened glass.

All glass units shall be fabricated with autoclaved edges on all four sides. All glass substrates shall be thoroughly cleaned and dried prior to the fabrication of units. Fixing of glazed panels to the aluminium extrusions shall not be support entirely by structural sealant.

Application of low-e coating to any side(s) of the laminated glass panel shall not be permitted. The spandrel panels shall be made of either minimum 10mm thick heat-strengthened glass or proprietary aluminium cladding panels in fluorocarbon finish or a combination of the above to achieve an integrated and distinctive building façade with an professional image appropriate to the police training facilities.

Flatness **20.2D** In addition to conforming to **BS 952-1, BS 952-2** and **ASTM C1048**, monolithic heat strengthened and tempered glass shall conform to the following flatness tolerances:

(a) Bow and warp have the same meaning. They are both defined as deviation of a glass surface from a true plane, with the glass free-standing or installed in a frame and positioned in a vertical plane.

(b) Localized bow refers to any straight line segment with a length of 300 mm on a glass surface.

(c) Overall bow refers to any straight line segment on a glass surface which extends between opposite edges across the smaller glass dimension and is perpendicular to at least one edge. The length of the line segment is the gauge length.

(d) Localized bow shall not exceed 1.6 mm.

(e) Overall bow shall not exceed: 1.0 mm per 300 mm for gauge length in the range zero to 1 m; 0.75 mm per 300 mm for gauge length in the range 1 m to 2.40 m; one half of the values listed in **ASTM C1048**, Table 2 for gauge lengths exceeding 2.40 m.

(f) Where heat treating results in essentially parallel ripples or waves, the maximum peak-to-valley deviation shall not exceed 0.127 mm. Requirements for localized bow and overall bow shall also be satisfied. Direction of ripples shall be consistent throughout the building and approved by the SO.

(g) The specified bow and ripple tolerances are intended as manufacturing quality control limits.

Inclusions in tempered glass **20.2E** Tempered glass shall be subject to quality control measures (i.e. heat soaking) to minimize inclusions that could result in spontaneous breakage. Such inclusions are defined as a material defect by this specification~~. Installed tempered glass which experiences spontaneous breakage shall be replaced (material and labour) under the warranty provisions.~~

Plastic films **20.2F** Plastic films used to opacify glass shall conform to the following requirements:

(a) Minimum nominal thickness of polyester shall be 0.08 mm. Film shall be pigmented and have a black colour unless otherwise stated.

(b) The bonding surface shall be completely coated with a solvent based adhesive.

(c) Monolithic opacified glass shall have a safety backing for fallout resistance.

Vision glass **20.2G** Vision glass shall be as specified in the Particular Specification.

Spandrel glass **20.2H** Spandrel glass shall be as specified in the Particular Specification.

Criteria for glass **20.2I** Performance requirements for glass shall be as follows:

(a) Structural design of glass shall be in accordance with the **Code of Practice for Structural Use of Glass** including its latest amendments and revisions issued by the Buildings Department.

(b) Provide heat strengthened glass where annealed glass would be vulnerable to thermal breakage.

Glass replacement **20.2J** Glazing details shall permit glass replacement after initial construction, shall permit reuse of original gaskets, shall permit replacement glass of the same nominal size as original glass, and shall not require cutting of framing members or removal of interior finishes. Vision glass in conventional frames shall be replaceable from the interior. Spandrel glass shall be replaceable from the exterior. Silicone supported vision glass shall be replaceable from the exterior and/or interior.

Glazing materials **20.2K** The minimum service life of all gaskets, weather stripping and other glazing accessories shall be 15 years. Gaskets and weather-strips, except at structural sealant glazing shall, as a minimum, conform to **BS 6262** except:

(a) Sponge gaskets shall be extruded black neoprene with a hardness of 40 +5/-4 durometer Shore A and conforming to **ASTM C509**. Design sponge gaskets to provide 20% to 35% compression. Sponge gaskets are only to be used as gap fillers and must not be used where the performance relies on compression resistance.

(b) Dense gaskets shall normally be black extrusions with a Shore A hardness of 70 +5/-4 for hollow profiles and 60 +5/-4 for solid profiles, and conforming to **ASTM C864** or **BS 4255-1**. Outdoor and indoor gaskets shall be silicone, EPDM, neoprene or a Thermoplastic Elastomer (TPE). However TPE gaskets are not permitted to be used where their performance is dependent upon compression resistance. Where the colour of the gasket is other than black, only heat cured silicone rubber is to be used.

(c) Where compatible with the installation procedures, all corners are to be vulcanized by transfer/injection moulding.

(d) Interior and exterior gasket profiles shall be designed to produce a glass edge pressure of not less than 0.70 N/mm, nor more than 1.75 N/mm.

20.2K(1)* (a) All gaskets/dry weatherseals shall be polychloroprene (neoprene) or similar, except where used in contact with a silicone sealant. Where in contact with silicone sealants, all gaskets and spacers shall be preformed heat cured silicone rubber, chemically compatible with the silicone sealant and suitable for thespecific purpose intended. All gaskets/weatherseals/spacers shall have continuous mechanical engagement to framing members; adhesive attachment is not acceptable.

(b) Sponge gaskets/weatherseals/spacers shall be extruded black neoprene or silicone rubber with a hardness of 40 ±5 durometer Shore A and conform to **ASTM C509** (for neoprene). All sponge gasket shall be compressed 20% to 35% in the final installed position.

(c) Gaskets and seals used to achieve the required weather and/or air-tightness shall be selected to accommodate fully the expected cladding movements, the range of dimension tolerances associated with fabrication and installation of the façade system. They shall be formed with materials capable of maintaining their elastic qualities, dimensions and resistance to physical and chemical attack sufficient to maintain the full acoustic performance during the design life. Cladding gaskets providing the water and air seals shall be formed into complete frames with factors formed injection moulded vulcanized corner joints.

(d) Gaskets jointed by bonding with adhesive are not accepted as a substitute for moulded frame gaskets, unless some unforeseen condition occurs.

(e) Gaskets shall be free from contact and migration stain and shall be compatible with all substrate, sealants and finishes with which they are likely to come into contact. The gaskets shall be free of mould flash.

(f) All cladding gasket frames should be normally manufactured to a small but predetermined oversize tolerance, to ensure that when sealed into position, the lineal lengths and corners of the gaskets are in slight compression.

Gaskets at structural sealant **20.2L** Gaskets at structural sealant glazing shall be as follows:

(a) Glazing gaskets, sealant backers within glazing pockets and continuous glass spacer pads at structural sealant shall be black heat cured silicone rubber.

(b) Notwithstanding these requirements, in recognition of the reliance on the resistance to compression for the performance of gaskets, the maximum in service compression set is limited to 25% over a time period equivalent to 1.15 times the design life of the building.

(c) Gaskets which maintain glass face clearance while serving as a backer for a silicone weather seal may have a friction fit. All other gaskets and weather strips, including backers for structural sealant, shall have a continuous spline or a continuous groove which engages a matching groove or leg on the aluminium frame.

(d) Double sided tape is acceptable as a glass spacer pad when used in conjunction with structural sealant, subject to verification of compatibility.

Thickness & weights of glass **20.2M** Thickness and weights shall be as in Table 20.1

TABLE 20.1
Thickness and Weights of Glass

Nominal thickness (mm)	Approximate weight (kg/m^2)		Minimum weight (kg/m^2)		
	Sheet	Float	Cast	Polished Wired	Cast or Figure Rolled
3	7.5	7.5	-	-	6.0
4	10.0	10.0	-	-	7.5
5	12.5	12.5	-	-	9.5
6	15.0	15.0	17	15.9	11.5
10	-	25.0	-	-	21.5
12	-	30.0	-	-	-

Glass to be of accurate size, with clean undamaged edges and surfaces which are not disfigured. In addition, the glass thickness shall comply with manufacturing specification and shall not be less than the minimum thickness adopted in design calculation.

Applied films **20.2N** Post applied films can constitute a risk to the integrity of the glass, either from a risk of increasing thermal stress or by damage caused to the glass during the application of the film. Therefore no post applied application of adhesive film, whether of solar control, security or decoration is permitted without the express written permission of the glass manufacturer.

Back-up material **20.2O*** Sealant back-up materials shall be jacketed, non-grassing, open cell polyolefin foam.

Custom designed shapes of compatible foam tapes shall be used when required for glass pocket shape.

Float glass **20.3** Unless otherwise specified glass shall be considered as clear float annealed glass of a minimum Q3 quality in accordance with **ASTM C1036** or **BS EN 572-2**.

Sheet glass **20.4** Unless specifically requested and confirmed in writing drawn sheet glass is not permitted to be used. Clear sheet glass shall be drawn of ordinary quality for glazing where it is permitted to be used.

Translucent & obscured glass **20.5** Translucent glass is considered as having:

(a) For monolithic glass
An acid etch or a sand blasted pattern or complete coverage on part or on the entire face of the glass.

(b) For laminated glass

A coloured sheet or gel as part of the interlayer makeup that provides a reduction in transparency.

Obscured glass is considered as being cast or rolled such that a raised pattern is formed that provides a reduction in the transparency of the glass. This pattern is an integral part of the glass.

Fire rated glass **20.6** Wired and other specialist glasses must have been successfully tested in accordance with the relevant clauses of **BS 476**.

(a) Wired cast glass and wired polished glass shall have a square mesh wire 13 mm square electrically welded at each intersection that is embedded into the glass to a depth equivalent to half the glass thickness.

(b) Wired glass is not considered a safety glass and can only be used in a non-fire rated installation with express permission.

(c) Non-insulating fire rated glass, other than wired soda lime glass should be borosilicate glass.

(d) Insulating fire rated glass can be of any composition if the relevant fire certificate can be provided.

Mirror glass **20.7** Mirror glass shall be selected float glass suitable for silvering and a minimum Q2 quality in accordance with **ASTM C1036**.

Mirrors shall have square or bevelled edges. Exposed edges are to be ground or polished smooth with an arrised edge.

20.7A* Mirror glass shall be 6mm thick, free from tarnishing, discoloration, scratches or other defects visible in the designed viewing conditions.

Shall be backed with an even coating of silver and two coats of shellac varnish or with other treatment to resist moisture.

Mirrors shall be fixed with 3 mm minimum air space at back.

Compressible sleeves and washers (e.g. polyethylene) shall be provided at screw fixings to isolate mirror from screws.

19 x 16 mm roll formed 18 gauge type grade 316 stainless steel frame and concealed hanging bracket shall be provided.

Adjacent or abutting mirrors shall be fixed in the same plane to avoid distortion.

Safety mirrors glass shall be 6 mm thick laminated to vinyl backing film which holds glass fragments in original positions even when mirror is accidentally broken.

One way mirrors shall be of an approved proprietary brand of fully tempered glass of thickness to suit opening sizes.

In addition to the full height mirror as required in the Room Data Sheets of each room/area, a continuous mirror (min. 750mm high) shall be provided for each counter (vanity top) on which basins are mounted. For each individual wall hung basin, one mirror of minimum size of 410 x 610mm shall be provided. Mirrors in accessible toilet shall conforms to the requirement of Design Manual - Barrier Free Access 2008 (2024 Edition).

Heat strengthened glass **20.8** (a) Heat strengthened glass shall be glass that has been heat treated to give increased strength, in accordance with the requirements of **ASTM C1048**, to approximately twice the strength and impact resistance of untreated float

glass. Heat strengthened glass shall be manufactured by a factory with ISO 9001 quality assurance certification.

(b) To be defined as Heat Strengthened glass, the residual surface compression must be between 24 and 52 MPa. Submit the glass manufacturer's quality control record on measurement of surface compressive stress by Grazing Angle Surface Polarimeter (GASP) with valid calibration certification in accordance with **ASTM C1279**.

(c) Glass with a surface compression in excess of 45 MPa is to be subjected to heat soak testing in accordance with the relevant procedures set out in **BS EN 14179-1**. Submit the compliance certificate for the glass delivered to site. The compliance certificate should include the following information:

(i) Identification of the batch;

(ii) Quantity and configuration of thermocouples used to measure the glass surface temperatures in the oven;

(iii) Graphs of the heat soak process cycle associated with each of the thermocouples indicating the glass surface temperatures at representative glass locations and time duration of the heating phase, holding phase and cooling phase of the process;

(iv) Name of the glass manufacturer;

(v) Location and identification number of the oven;

(vi) Calibration report of the oven;

(vii) Date of carrying out the heat soaking process;

(viii) Quantity and size of glass subject to the heat soaking process and records of breakages of panels in the tests with corresponding oven numbers; and

(ix) Minimum dimension of glass separation in the oven.

(d) Heat strengthened glass is not to be considered a safety glass.

Fully tempered glass **20.9**

(a) Fully tempered glass shall be glass that has been heat treated to give increased strength, in accordance with the requirements of **ASTM C1048**, to approximately four times the strength and impact resistance of untreated float glass. Fully tempered glass shall be manufactured by a factory with ISO 9001 quality assurance certification.

(b) To be defined as Fully Tempered glass, the residual surface compression must be a minimum of 69 MPa, however it is recommended that the glass supplied as fully tempered has a minimum of 75 MPa. The manufacturer's quality control records during glass production shall include the following:

(i) Measurement of surface compressive stress by GASP with valid calibration certification in accordance with **ASTM C1279**.

(ii) Fragmentation test carried out to each batch of tempered glass in accordance with **BS EN 14179-1** after the heat soak treatment.

(c) It must also be noted that heat soak testing in accordance with **APP-37**, **APP-53** and **APP-110** where applicable to the satisfaction of the SO, which is based upon the methodology of **BS EN 14179-1**, must be undertaken for

glass supplied as fully tempered. Therefore, it is to be subjected to heat soak testing in accordance with the relevant procedures set out in **BS EN 14179-1**. The Contractor shall submit for approval the following items:

(i) A quality supervision plan for the quality supervision of manufacturer's heat soak process of the tempered glass to be used.

(ii) The name, experience and qualification of the TCP who shall be appointed by the Contractor to provide full time continuous supervision of the heat soak process of all tempered glass panes in the factory.

(iii) The compliance certificate for the glass delivered to site. The compliance certificate should include the information as mentioned in Clause 20.8(c) and the manufacturer's quality control records as stated in Clause 20.9(b).

(d) Fully tempered glass is considered a safety glass as upon fracture it would break into small fragments.

20.9A* (a) All tempered glass shall be heat soak tested at approximately 275°C. Test shall be conducted when center of glass temperature is at 275°C for roughly one hour.

(b) The minimum heat up times of the furnace shall be as follows:

Glass Thickness	Min. Heat Up Time
6mm	30 minutes
10mm	70 minutes
12mm	120 minutes
19mm	270 minutes

(c) Heat output of the furnace and glass area in each test batchshall be monitored and controlled to comply with the above.

(d) Cool down time to be approximately one half the heat up time.

(e) Hold glass vertically during testing, with a minimum space of 25mm between glass lites.

(f) Each glass lite (100%) shall be subject to one cycle of testing.

(g) Tempered glass shall conform to **ANSIZ97.1.**

(h) Heat-treated flat glass shall conform to **ASTM C 1048-04**.

(i) **BS 952-1** or **ASTM C1036 & C1048** for uncoated heat treated glass and **ASTM Cl376** for coated flat glass and of approved manufacturer free from bubbles, smoke vanes, air notes, scratches or other defects and cut to fit the rebates with due allowance for expansion.

Tinted glass **20.10** Tinted glass shall be body tinted of the colour and intensity specified. This type of glass is to be considered as a heat absorbing glass when used externally and is to have a heat treatment that conforms to the 'heat strengthened' category of **ASTM C1048** as a minimum.

Coated glass **20.11** Coated Glass

(a) Coated glass shall be an approved proprietary product with either

(i) A metallic mirror-like reflective coating on the designated surface to the colour and of the type and performance specified or

(ii) A pyrolytic or vacuum deposition low emissivity (Low-E) coating of the colour and of the type and performance specified in the Particular Specification.

(b) All coated glass must conform to the requirements of **BS EN 1096-1** to **4** as a minimum but shall also conform to the requirements of the Particular Specification.

(c) The thermal performance and other properties of the glass shall conform to the criteria in the Particular Specification.

Laminated safety and security glass

20.12 Laminated Glass, dependent upon its composition can be regarded as a safety glass or a security glass.

(a) Laminated glass shall be an approved proprietary product comprising of two or more sheets of glass bonded together and incorporating a plastic interlayer, or other method of bonding, to ensure the performance specified.

(b) Glass must conform to **BS 6262-4** as a minimum and is considered a safety glass if it has been tested to **BS EN 12600** and is in conformance with the category 1 as a minimum, or categories 2, 3 when specified by design requirement.

(c) Other national standards that are equivalent to **BS EN 12600** are also acceptable but must be submitted and approved before the glass can be considered as a safety glass.

(d) Where non-pyrolytic Low-E coatings are used, edge deletion of the coating is necessary unless specifically stated as not being required by the glass manufacturer. Reference can be made **ASTM C1172** or other equivalent international standards for non-pyrolytic Low-E coatings.

(e) When laminated glass is used in a sloped condition, that is at angle from the vertical in excess of 10°, and heat treated glass is required for thermal or strength reasons, the inner lite is to heat strengthened and not fully tempered.

(f) Where laminated glass is used as a security glass to protect persons, it must have been tested to ensure compliance with the relevant threat level.

(g) Certification is required for glass used in bullet resistance or blast resistant installations.

(h) The addition of an applied adhesive film, either to the external face or the internal face will not be considered as, and does not constitute, an upgrading of the glass from that originally supplied.

(i) Laminated glass shall be subjected to boil test by the glass manufacturer in accordance with the requirements in Clause 8.1.6 of the **Code of Practice for Structural Use of Glass** issued by the Buildings Department to confirm the lamination quality before the production of glass. Submit the compliance test report for the glass delivered to site.

20.12A* The glass panels used in glass wall, glass canopy and skylight shall be laminated glass made of minimum 8mm clear heat-strengthened tinted glass + 1.52mm thick PVB interlayer + 8mm clear heat-strengthened glass, with custom designed fritted pattern (allowing possibly at 2 surfaces of the laminated glass) and shall either be supported on spider clamps or held in position by structural sealant. In any case, glass shall not be entirely supported by structural sealant while support and/or glazing beads shall be minimized when viewed from outside.

In locations with special aesthetic concern, such as the main entrance or any featured atrium with skylight etc, low-iron glass and SGP interlayer (for laminated glass) are preferred; in that case, glazing beads could possibly be removed to achieve a frameless design, subject to the design concept and structural calculation.

Plastic glazing **20.13** All plastic glazing installations are subject to the same test and certification requirements as for conventional glass.

(a) Plastic sheet glazing material shall be an approved proprietary product of one of the following types:

(i) Polycarbonate.

(ii) Polycarbonate with surface hardened treatment.

(iii) Other plastics as specified in the Particular Specification.

(b) Plastics shall be cut in conformance with the manufacturer's requirements, including the removal of protective tapes and papers. All surfaces shall be free from irregularities and defects.

Setting blocks **20.16** Setting blocks shall be heat cured silicone, EPDM or neoprene. Setting blocks are to support the glass for a minimum of 80% of the glass thickness and are to be 80 - 90 Shore A hardness. They shall have a length equivalent to 25 mm for every 1 m^2 of glass area, with a minimum length of 100 mm, and a minimum width suitable to the glass thickness, a minimum of 80% of the glass width shall be fully supported.

Locating blocks shall be heat cured silicone, EPDM or neoprene. Location blocks are to cover a minimum of 80% of the glass thickness and are to be 60 - 70 Shore A hardness.

Thermoplastic elastomers, such as Santoprene and PVC or similar materials are not permitted.

20.16A* Setting blocks shall be dense heat cured silicone rubber with a hardness of 80-90 durometer Shore A. Setting blocks shall be located at quarter points, or in accordance with FGMA glazing guidelines.

Side blocks shall be dense heat cured silicone rubber with a hardness of 60-70 durometer Shore A.

The material used shall not include any carbon compounds that could leach out over time and cause staining.

Glazing compounds **20.17** Glazing compounds are to be selected to suit the frame and glazing substrates.

(a) The following compounds are permitted to be used:

(i) Silicone – gunnable neutral cure silicone one part weather type sealant if glass is retained mechanically. One or two-part structural sealant for glass not retained on all edges.

(ii) Polysulphide – is permitted only if the glass is positively retained on all edges.

(iii) Putty – is permitted for glazing into wooden frames only. Putty for glazing to softwood and absorbent hardwoods shall be linseed oil putty to **BS 544**. Putty for glazing to non-absorbent hardwoods shall be an approved proprietary brand recommended by the

window manufacturer for the particular application and with setting properties and unpainted life to suit the construction programme.

(b) Compounds for glazing plastic sheets shall be compatible with the proprietary sheets and are to be either silicone or polysulphide.

(c) All sealing compounds are to be tested for adhesion and the test reports submitted prior to the commencement of glazing.

Environmental Green Requirements **20.36** Green requirements of adhesives and sealants:

(a) The product of adhesive and sealant shall comply with the VOC content limits on regulated adhesives stipulated in the Air Pollution Control (VOC) Regulation of Hong Kong.

(b) The product shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride).

(c) The product shall contain no more than 0.01% by wet weight of formaldehyde.

(d) The product shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

In-glass Digital Printing **20.37*** The in-glass digital printing technology shall be applied to external façade or internal glass partitions where images, graphics or patterns on glass are applied.

Supplied by multi-color photorealistic images, graphics, patterns, textures, opacity, transparency, gradients and/or etch effects on tempered glass and/or laminated glass panels using In-glass Digital Printing technology.

Digital printing images / picture shall be high-resolution, ceramic inks to be used, long-lasting, consistent appearance.

All printed glass shall be treated with a tempering or firing process to allow ink to penetrate the glass. The glass shall be scratch-resistant, UV-fading resistant, and resistant to other chemicals to ensure the protection from extreme weather conditions.

The chemical durability of glass enamels is evaluated according to **ASTM C724-91** - Standard Test Method for Acid Resistance of Ceramic Decorations on Architectural-Type Glass. This test method evaluates the quality and serviceability of a ceramic decoration on architectural type glass. The degree of attack is determined, both quantitatively and qualitatively, using an acidic solution.

All colors have been evaluated and show no visible sign of attack or leaching by water. When applied and fired correctly, the enamel meets the strict chemical resistance levels, according to **ASTM C724-91**. For hydrochloric acid, acetic and citric acid; the enamel is sulfuric acid resistant and has excellent alkali chemical resistance. The ink color has been proven to have long-term durability, with older projects showing no deterioration. In addition, printed glasses with ceramic inks of the manufacturer have passed the Artificial Weathering and Exposure to Artificial Radiation standard, in according with **ISO 11341** for paints and varnishes, so we are confident about performance and the durability of the ink color.

In order to evaluate the scratch resistance of the printed glass, a Braive sclerometer with a force of up to 30N is applied. When the ink is properly fired, the scratch marks are eliminated completely.

In-glass Digital Printing has obtained the German accreditation **ABZ 70.1.75**, as well as the European **ETAG 002**. The adhesion test is performed by a crosshatch or tape test. Results show that the resistance of the printed area is excellent.

The UV durability of the produced enamel is guaranteed for many years, with minimal optical degradation in temperature range of -30ºC to +65ºC. It is interesting to remember that inorganic pigments, similar to those used in our manufacturer's inks, were used in ancient glass-staining methods, and their continued vibrancy proves the ultimate test of time.

All Spectrum Inks and Flushing Fluid are within the limits of less than 1000 ppm of lead and 100 ppm of cadmium, respectively and therefore considered free of heavy metals. This is in line with the **GADSL** list version 1.0, released on 01-02-2010 (for details see: www.gadsl.org). The ceramic raw materials have gone through analysis by **ICP-MS** (Inductively Coupling Plasma Mass Spectrometry).

Also offered by printing machine is the ability to print a ceramic frit perimeter band on any glass without having to make multiple screens. In our experience, it is possible to bend the printed glass by at least 80°, without damaging the printing. Bending radius will be according to the glass thickness and type.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 21

PAINTING

SECTION 21
PAINTING

Generally **21.1** All paints and decorative materials shall be of approved type, brand and colour.

Obtain approval of the SO in respect of the painting system which shall include the type, brand and colour of all materials before starting work.

Supply all proprietary brand materials in sealed containers each containing the manufacturer's brand label and printed instructions. Destroy the tins immediately after use of the contents.

Paint shall be supplied in sealed containers. Each container shall be marked on the side to show the following:

(a) The name of the manufacturer,

(b) The paint manufacturer's reference number,

(c) Intended purposes, type of pigment and binder,

(d) Batch number, date of manufacture, expiry date and pot life, and

(e) Colour, gloss, drying times and flash point.

Where possible, all the materials in any coating system shall be obtained from the same manufacturer. Furnish the SO with two copies of the manufacturer's data sheets for the paints proposed to be used.

Store materials on the Site or in the Contractor's workshops, etc in cool, well ventilated, covered storage space. Label tins of paint for "External Use" and for "Internal Use", "Undercoating" and "Finishing" respectively.

Where flammable paints or solvents are used, no smoking shall be permitted. Appropriate signs as required by the SO should be displayed.

Priming paints in general **21.2** Priming paints to be as follows:

(a) For synthetic finishing paints on internal and external woodwork, use aluminium primer to **BS 4756**, Type 1.

(b) For synthetic finishing paints on internal and external metalwork, use zinc phosphate primer to **BS 5193, ISO 6745** or metallic zinc-rich primer to **BS 4652**, as specified.

(c) For synthetic or non-toxic paints on galvanized metal surfaces, use an approved etching primer with a zinc-chromate base, or calcium plumbate primer to **BS 3698**.

(d) For polyurethane paint on internal and external metalwork, use polyurethane red lead primer.

21.2A* Priming paint for use in the preparation of surfaces to be as follows:

(a) For lime plaster, use prime lime or acrylic alkali resisting primer.

(b) For brickwork, use acrylic alkali resisting primer.

Priming paints for Structural Steel **21.3** For painting on structural steelwork, comply with Section 15.

Sealers **21.4** Sealers for plaster, masonry and the like shall be an approved stabilizing solution or oil-based plaster sealer.

21.4A* (a) Sealers for fair-faced concrete to be as follows:

(i) The material shall be isobutyltriethoxysilane.

(ii) The material shall possess the following properties or manufacturer's latest properties –

Content isobutyltriethoxysilane	>= 98.9 %
Content Siloxane	<= 0.3 %
Hydrolysable Chloride Content	<= 100 ppm
Specific Gravity	0.88
Refractive Index	1.40
Penetration	15-25mm

(iii) The material shall be 100% active with no diluting by solvent or other fluid.

(b) Sealer for teak floor to be as follows:

(i) Seal all teak floors with three coats of accepted resin based sealer, satin or gloss finish as required or equal and accepted, one pack epoxy floor sealer, to prepared timber flooring.

(ii) The top surface shall be applied with clear polyurethane coating and polished with electric polishing machine.

Anti-mould liquid **21.5** Anti-mould liquid shall be an approved fungicidal solution.

Water repellent liquid **21.6** Water repellent liquid shall be silicone or other approved water repellent.

Limewash **21.7** Lime wash shall be composed of 15 kg of tallow to 1 m^3 of quicklime for walls, ceilings, etc. and 55 kg of tallow to 1 m^3 of quicklime for bituminous felted or asphalt roof surfaces.

21.7A* The lime is to be broken into small lumps and the tallow shredded and placed on top of the heap. Sufficient cold water is to be added so that the heat developed in slaking is sufficient to melt and disperse the tallow within the mass without becoming charred.

When the slaking is completed, water is to be added to enable the mass to be worked into a stiff cream and screened to remove lumps if necessary. The lime wash is to be applied in a thin film which appears dark in colour on application but dries white.

Two or more coats are to be applied as required to prepared surfaces.

Emulsion paint **21.8A*** Emulsion paint shall be plastic, vinyl, latex or acrylic resin based emulsions of approved brands. Do not use alkyd resin based emulsion paints without prior approval.

Emulsion paint from accepted source shall be supplied and used direct from the manufacturers containers, and applied in two coats to prepared surfaces.

Textured emulsion paint **21.9** Textured emulsion paint shall be acrylic based emulsion paint textured with a finely dispersed aggregate.

Anti-mould acrylic emulsion paint & Anti-mould performance **21.10A*** Anti-mould emulsion paint shall be washable solvent acrylic resin based emulsion of matt, semi-gloss or gloss finish incorporated an approved fungus resistant chemical and resist discoloration and chalking by strong cement chemicals.

A compatible water-based undercoat wall sealer in modified acrylic copolymer emulsion with anti-fungus property shall be provided according to the manufacturer's instruction.

Painted surfaces with exposure to indoor environment shall comply with Rating 0 requirement of **BS 3900-G6**.

Multi-colour paint **21.11** Multi-colour paint shall be an approved brand comprising a base and hardwearing top coat incorporating a pigmented splatter coat used as recommended by the manufacturer.

Cement paint **21.12A*** Cement paint shall be waterproof cement base paint supplied in drums to prepared surfaces. Do not mix lime or other adulterants with cement paints.

External textured paint **21.13A*** External textured paint shall be heavy duty masonry paint system or fluorocarbon textured external coating system as specified.

(a) Heavy duty masonry paint system

An approved heavy duty masonry paint incorporating a fine aggregate filler, composed of water-based acrylic resin undercoat sealer, water-based modified acrylic resin spray body texture coat and water-based acrylic urethane resin top coats.

The textured paint shall feature superb dirt resistant, excellent film performance to resist all kinds of weather and resist various types of microbes including mould, fungus, algae, etc. and provide hygienic environment.

(b) Fluorocarbon textured external coating system

Fluorocarbon textured external coating system shall be a spray applied system, with semi-gloss and accepted textured surface. The final finish must be uniform in colour consistency, texture, and free from surface irregularities. The surface colour and glossiness shall remain more than 90% after 20 years of weather exposure.

(i) The fluorocarbon textured external coating system shall consist of the following:

Primer (1 coat)
Texture Compound (1 coat)
Water Base Intermediate Coat (1 coat)
Water Base Fluorocarbon Topcoat (1 coat)

(ii) Primer for fluorocarbon textured external coating system shall be acrylic silicone resin base with physical properties that meet following standard:

Test Items	Requirement	Standard
Water Resistance	Unchanged	Immersed 96 hours in tap water
Alkaliproof	Unchanged	Immersed 168 hours in saturated solution of calcium hydroxide

Green Label Scheme	Awarded	**HK Green Label Certificate** of Green Council under category GL-005-003

(iii) Texture compound for fluorocarbon textured external coating system shall be water base acrylic resin, with physical properties that meet the following standard:

Test Items	Requirement	Standard
Crack Resistance by Initial Drying	Passed	No cracking
Bond Strength (Normal)	Passed	1.0 or above
Bond Strength (After immersed)	Passed	0.7 or above
Hot-cold repetition test	Passed	There shall be no peelings, cracks, blisters, nor outstanding color changes, gloss drops on the test specimen surface
Water resistance Method B (ml)	Passed	0.5 or below
Impact	Passed	No cracking, no apparent subject change and no excessive distortion
Weather resistance Method A	Passed	There shall be free from cracking and peeling, and discoloration shall be grey scale No. 3 or over
Green Label Scheme	Awarded	**HK Green Label Certificate** of Green Council under category GL-005-003

(iv) Water base intermediate coat for fluorocarbon textured external coating system shall be synthetic resin base, with physical properties that meet the following standard:

Test Items	Requirement	Standard
Water Resistance	Unchanged	Immersed 96 hours in tap water
Alkaliproof	Unchanged	Immersed 168 hours in saturated solution of calcium hydroxide

(v) Water base fluorocarbon topcoat for fluorocarbon textured external coating system shall contain > 29% fluoropolymer emulsion resin, exhibit easy cleaning or soil release property, with physical properties that meet the following standard:

Test Items	Requirement	Standard
Stability at lower temperature (-5^0C)	Passed	No change in quality

Test Items	Requirement	Standard
Workability	Passed	No obstacle to apply

		materials twice by brush
Drying time	Passed	Less than 2 hours at 20^0C
Appearance	Passed	No change in the appearance of paint film
Hiding ability	Passed	Over 0.96
Specular gloss	Passed	Over 70
Water resistance	Passed	Immersion I water for 96 hours. The gloss retention ratio is over 80% and there is no change in the paint film.
Alkali resistance	Passed	Immersion in alkali for 7 hours. The gloss retention ratio is over 65% and there is no change in the paint film.
Washability	Passed	Possible to resist washing for 1,000 times
Salt resistance	Passed	**JIS K5400** 8.23 for 3000 hours, no damage observed on the dense film
Heat resistance	Passed	The gloss retention is over 80% and possible to resist the repetition of heat and cold
Dirt resistance	Grade 5 (max. value)	Value of grey scale after outdoor exposure test for 1 year
Accelerated weather test	Passed	Tested by sunshine carbon arc type weather-o-meter for 2,000h and gloss retention ratio is over 80%.
Condition in container	Passed	When being stirred, it makes uniform condition without any hard lumps
Application properties	Passed	When making twice coating, no impediment for brushing work
Humidity and cool-heat cycling resistance	Passed	Gloss retention of 80% or more and endurable for humidity and cool-heat cycling test.
Water permeability (Method B)	< 0.5 ml	**JIS A 6909 (**measure the permeated water amount in 24 hours by using a water-permeated tester, and take the value of permeated water amount converted to per 1 m^2 of paint film as the water permeability of the paint film)

Fire retardant paints **21.14** Fire retardant paints shall be paints which, when used alone or in conjunction with other paints applied to combustible substrates in accordance with a manufacturer's tested system, achieve Class 1 spread of flame rating to **BS 476-7**.

Synthetic paint **21.15** Unless expressly specified otherwise, all paint for internal and external use shall be synthetic paint of alkyd resin base combined with drying oils and pigments. Undercoats and finishing coat shall be of properly matching type and the finishing coat shall give a hard gloss finish or as otherwise specified.

Cold cure epoxy paint **21.16** Cold cure epoxy paint shall be of an approved Two Pack Type.

Polyurethane paint **21.17** Polyurethane paint shall be of the Two Pack Type and part of an approved system.

Black bitumastic paint **21.18** Black bitumastic paint shall be tar base paint complying with the requirements of **BS 1070**, Type B (quick drying).

Black bitumen coating solution **21.19** Black bitumen coating solution shall be to **BS 3416**, Type 1 for general purposes.

Marking paint for ballcourts, playgrounds etc. **21.20** Marking paint for basketball courts, playground, etc. shall be an approved purpose made synthetic non-skid marking paint, with a drying time not exceeding 30 minutes.

Marking materials for roads, carriageways and car parks **21.21** Road marking materials shall be hot applied thermoplastic materials with either plasticised synthetic hydrocarbon resin or alkyd resin as the binder as specified.

(a) Type 'A' - Standard hot applied thermoplastic material

(i) The material shall comply with **BS 3262-3, BS EN 1824** and **BS EN 1871** except for the following modifications to the material properties:

Softening point measured in accordance with Annex F to **BS EN 1871** shall be not less than 85ºC, and

(ii) The luminance factor when tested in accordance with Annex E of **BS EN 1871** shall be Class LF4 for white material and Class LF2 for yellow material.

(b) Type 'B' - Alkyd resin hot applied thermoplastic material

(i) The material shall comply with **BS EN 1824** and **BS EN 1871** except for the following modifications to the material properties:

Softening point measured in accordance with Annex F to **BS EN 1871** shall be not less than 85ºC, and

(ii) The binder for alkyd resin thermoplastic road marking materials to consist of maleic-modified glycerol ester of wood resin. The binder shall not contain petroleum based hydrocarbon resins, tall oil resins, blends of tall oil and wood resin or similar derivatives.

(iii) The luminance factor when tested in accordance with Annex E of **BS EN 1871** shall be Class LF4 for white material and Class LF2 for yellow material.

Fluorescent paint **21.22** Fluorescent paint to **BS EN ISO 11507, BS 3900-F16** and **BS EN 927-6** where appropriate shall be water based or oil based, as specified. Use fluorescent paint in conjunction with white flat water or oil base undercoat, and priming coat to suit the surface being painted.

Reflecting paint **21.23** Reflecting paint shall consist of white synthetic paint with a high gloss finish and a surface coating of fine grain reflective aggregate, applied at the rate of not less than 0.6 kg/m^2 while finishing coat is still wet.

Metallic paint **21.24** Metallic paint shall be composed of acrylic resin solution base mixed with finely divided aluminium to give a bright finish, or finely divided copper or copper alloy to give a bronze finish.

Heat resisting paint **21.25A*** Heat resisting paint shall be an approved heat resisting enamel or aluminium paint. Priming coat and undercoats used in conjunction with the enamel finishing coat shall be similarly heat resisting.

(a) Heat resistant aluminium paints for use up to 400ºF shall be paint with cyclised rubber base of accepted brand.

(a) Heat resistant aluminium paints for use over 400ºF shall be paint with silicon resin base, of accepted brand.

Chemical resisting paint **21.26** Chemical resisting paint and thinner shall be of an approved brand resistant to attack by all commonly used commercial acids and alkalis.

Black enamel **21.27** Black enamel shall be high grade, quick drying black japan and to dry to a perfectly smooth, hard and elastic surface in not more than 12 hours at a temperature of 16ºC.

Non-toxic paint **21.28** Non-toxic paint for use on water tanks, water collecting roofs etc. shall be proprietary brands and one of the following types:

(a) Petroleum or asphaltic bitumen based coatings, or

(b) Epoxy based coatings

Pesticidal coating **21.29** Pesticidal coating shall contain an approved pesticide.

Wood preservative **21.30** Wood preservative to offer complete protection against termites, wood boring insects, fungi, wood rot and decay. It shall be of an approved proprietary brand exterior grade, where completely concealed or not decorated, and colourless, coloured or suitable for overpainting where likely to be exposed or be in contact with a painted finish.

Knotting **21.31** Knotting for metal pipes coated with bitumen shall be an approved proprietary brand of patent knotting intended for this purpose. Knotting for woodwork shall be to **BS 1336**.

Stopping **21.32** Stopping for internal woodwork, plywood, hardwood and fibreboard shall be poly putty or linseed oil putty**,** tinted if required. Stopping for external woodwork shall be poly putty or white lead paste and gold size, well mixed.

White spirit **21.33** White spirit shall be to **BS 245**.

Linseed oil **21.34** Linseed oil shall be to **BS EN ISO 150**.

Stain **21.35** Stain for woodwork shall be an approved water or spirit stain suitable for use under varnish or wax polish.

Self finished stains shall be an approved proprietary make.

Varnish **21.36** Varnish shall be one of the following types:

(a) Copal Varnish shall be No. 1 Extra Pale quality for internal use only.

(b) Synthetic Varnish shall be the Long Linseed Oil Alkyd type for internal or external use.

(c) Polyurethane Varnish for internal or external use shall be either:

(i) Moisture Cure Oil Modified One Pack Type, or

(ii) Isocyanate Cure Two Pack Type.

Wax polish **21.37** Wax polish for floors, furniture and joinery shall be an approved proprietary brand.

Chalkboard paint **21.38** Chalkboard paint shall be an approved hard drying flat black or deep green paint, containing a fine abrasive.

Cellulose lacquer **21.39** Cellulose lacquer shall be of an approved brand.

Stone cleaner **21.40** Chemical solutions for cleaning and sealing stonework shall be from an approved manufacturer.

Floor seal **21.41** Floor seals shall be an approved resin based sealer.

21.41A* Floor seals for teak floor shall be resin based sealer, satin or gloss finish as required or equal and accepted, one pack epoxy floor sealer, to prepared timber flooring.

The top surface shall be applied with clear polyurethane coating.

Reflectorization of road marking materials by surface application **21.73** For types 'A' and 'B' road marking materials, surface retro-reflectivity shall be accomplished as follows:

(a) Solid glass beads shall be incorporated in the road marking materials prior to application on site. Solid glass beads to comply with Glass Bead Medium Grading requirements of **BS 1423**.

(b) The retro-reflectivity of all road markings shall be enhanced by the application of solid glass beads at the rate of 400 to 500 g/m^2. The beads shall be applied concurrently with the line. The solid glass beads shall comply with Class B requirements of **BS 1423**.

(c) Solid glass beads shall be applied on site by mechanical means to the SO's satisfaction. Where solid glass beads cannot be satisfactorily applied by mechanical means they may, with prior approval, be applied by manual methods.

Test Certificate and routine testing of road marking materials **21.75** When required by the SO, a test certificate prepared and signed by an independent laboratory shall be submitted prior to the commencement of the Works certifying that samples taken from the materials shall be used in the Works to comply with **BS EN 1824** and **BS EN 1871**.

Environmental Green Requirements **21.90**

(a) All paint products shall comply with the VOC content requirements on regulated paints stipulated in the **Air Pollution Control (VOC) Regulation of Hong Kong**.

(b) Green requirements of Varnish and Wax Polish:

(i) The products shall not contain the following substances regulated in the Montreal Protocol on Substances that Deplete the Ozone Layer (particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride).
(ii) The product shall contain no more than 0.01% by wet weight of formaldehyde.
(iii) The product shall contain no more than 0.5% by wet weight of the sum total of aromatic compounds, which must include benzene, toluene, xylenes, and ethylbenzene.

(c) Green requirement of Paint and Thinner:

(i) The product shall contain no more than 0.01% by wet weight of formaldehyde.

(d) Green requirement of Paint and Varnish Remover:

(i) The VOC content of the product shall be less than 5% by volume.

QUALITY CONTROL TESTING

Emulsion paint **21.91** The quality tests for emulsion paint shall be as follows:

Test Items		Test Method	Acceptance Standards
Preliminary examination of paint	Surface skin	**BS EN ISO 1513**	- No surface skin
	Consistency		- No gelling
	Colour separation into layers		- No colour separation
	Visible impurities		- No visible impurities
	Sediment		- No hard settling
Drying times	Hard drying (min)	**BS EN ISO 9117-1**	< = 1 hour
Fineness of grind (μm)		**BS EN ISO 1524**	< = 50 μm
Hiding power (contrast ratio %)		**BS EN ISO 2814; BS 3900-D4**	> = 75%
Gloss value (GU) (at 85° specular reflection)		**BS EN ISO 2813**	< = 20
Viscosity (procedure B)		**ASTM D562**	65 - 85 KU
Scrub resistance (cycle)		**ASTM D2486**	> = 400 cycles

Synthetic paint **21.92** The quality tests for synthetic paint shall be as follows:

Test Items		Test Method	Acceptance Standards
Preliminary examination of paint	Surface skin	**BS EN ISO 1513**	- No surface skin
	Consistency		- No gelling
	Colour separation into layers		- No colour separation
	Settling		- No hard settling
	Extraneous matter		- No extraneous matter
Viscosity (Flow Cup No.6) (sec)		**BS EN ISO 2431**	45 to 60 sec
Drying times	Surface drying (hour)	**BS EN ISO 9117-3**	< = 4
	Hard drying (hour)	**BS EN ISO 9117-1**	< = 18
Fineness of grind (μm)		**BS EN ISO 1524**	< = 25 μm
Hiding power (contrast ratio %)		**BS EN ISO 2814; BS3900-D4**	> = 85%
Gloss value (GU) (at 60° specular reflection)		**BS EN ISO 2813**	> 80
Bend test		**BS EN ISO 1519**	No coating crack at 3 mm mandrel
Scratch test (g)		**BS EN ISO 1518-1**	> = 600

Multi-layer acrylic paint **21.93** The quality tests for multi-layer acrylic paint shall be as follows:

Test Items	Test Method	Acceptance Standards	Remarks

1. Low Temperature Stability	Table 2 **JIS A 6909**	No lumps and free from separation and aggregation of the composing materials	Respective coatings of primer coating, main coating and top coating are regarded as the samples.
2. Change in Consistency	Clause 5.6 **JIS A 6910** Table 2 **JIS A 6909**	± 15%	Respective coatings of primer coating, main coating and top coating are regarded as samples.
3. Cracking Resistance due to Initial Stage Drying	Clause 5.7 **JIS A 6910** Table 2 **JIS A 6909**	No cracking shall occur.	
4. Adhesion Strength	Table 2 **JIS A 6909**	Standard condition $> = 68.6$ N/cm^2 Immersion in water $> = 49.0$ N/cm^2	
5. Repeated Warming and Cooling	Table 2 **JIS A6909**	No peering, cracking and blistering and remarkable discolouration and degradation in luster on the surface.	
6. Permeability	Table 2 **JIS A 6909**	$< = 0.5$ ml	
7. Impact Resistance	Clause 5.11 **JIS A 6910** Table 2 **JIS A 6909**	Cracking, remarkable deformation and peeling shall not occur.	
8. Weather Resistance	**ASTM G154-16**	Cracking and peeling shall not occur and the discolouration shall be No.3 or subject to approval by the SO.	The test conditions: Fluorescent UV Lamp: UVA-340 Cycle: 24 hours UV at 60°C Total exposure time: 500 hours
9. Determination of Resistance to humid atmospheres containing sulphur dioxide	**BS EN ISO 3231;** **BS 3900-F8**	No blistering, loss of adhesion, rust staining, change of colour, embrittlement and other signs of deterioration.	The amount of sulphur dioxide to be used in testing is one litre. The test cycle to be 12 cycles.
10. Resistance to Fungal Growth	**BS 3900-G6**	Rating 0, no fungal growth.	

Notes:
1. The colour of paint to be tested shall be selected by the SO;
2. The base plate for testing to be 20 mm thick cement mortar board.

Washable epoxy wall paint **21.99*** Shall be composed of two components water thinned epoxy sealer and epoxy finishing coat. The proprietary epoxy wall paint shall be washable, easy-to-clean, anti-fungal, dust proof and chemical resistant.

External Paint **21.100*** (a) The paint system shall be a water-based inorganic mineral silicate system with self-cleaning technology built in the paint film designed for long term durability. The system shall repel water and dirt from the building façade and protecting concrete from acid rain, sea wind and salt water.

(b) The mineral paint system should develop an integral chemical bond with cement concrete and being an integral part of the concrete after fully cured. The mineral coating shall also be effective in against paint peeling off by resisting negative vapor pressure building up beneath the paint film often find in retenting wall and moist building substrate. The paint system comprises of one coat of mineral dilution/ primer and two coats of inorganic mineral silicate topcoat.

(c) Requirements of the external paint system:-

(i) Excellent resistance to water, alkaline, lime and chemicals, which cause saponification, uneven discoloration and efflorescence.
(ii) Repel dust particulars and exhaust gas in the atmosphere and allow the surface to exhibit excellent dirt-resistant properties.
(iii) Fungus and algae growth resistance.
(iv) Good adhesion on stable surfaces
(v) Anti-carbonation.
(vi) Resist deterioration causing by ultra violet (UV) radiation, ozone, oxygen, heat and humidity
(vii) Safe to use (water based, without toxic solvent), odourless and non-flammable.
(viii) Weather resistance.
(ix) Resistance to humid atmosphere containing sulphur dioxide
(x) Anti-dust, self-cleaning and easy to maintain

(d) The testing of the VOC content of paint shall be in accordance with General Specification.

(e) The performance requirements for inorganic mineral-based dirt & water repelling exterior coating system (smooth) shall be as follows:-

Test Items	Test Method	Acceptance Standards
Accelerated Weathering	**DIN EN ISO 16474-1**	No Flaking, No Cracking , No Blistering , No Yellowing after 1000 hrs
Liquid Water Transmission	**DIN EN 1062-3**	Class W3
Water Vapour Transmission	**DIN EN ISO 7783**	Class V1
Resistance to Salt Spray	**DIN EN ISO 9227**	No Cracking , No Blistering, No Flaking after 1000 hrs.
Resistance to Sulfur Dioxide Humidity	**DIN EN ISO 3231**	No Cracking , No Blistering, No Flaking after 1000 hrs
Water & Dirt Repelling Effect	**DIN EN 828**	Water contact angle ~155-161 degree "Lotus-Clean" Effect
Water Repellency	**DIN 4180**	Passed
Wet Scrub Resistance	**DIN EN 13300**	Klasse 2
Resistance to Fungal & Algae	**BS 3900:G6**	Rating 0, no fungal growth
Resistance to Fungal & Algae	**DIN EN 15457**	Effective
Pull-Off Adhesion	**BS EN ISO 4624**	Exceed / Equal to 1.2 MPa

Epoxy flooring **21.101*** (a) Type A – General Purpose

Shall be a complete proprietary system of hard-wearing epoxy floor coating comprising compatible primer, hardener (as appropriate) and top sealing coat. Epoxy floor coating system shall be minimum 0.5mm thick with anti-slip grain and coved skirting and be able to withstand the designed loads/traffic with good abrasion resistance. The layer shall be impermeable to prevent infiltration of liquid into the floor in case of leakage or spillage.

(b) Type B

Shall be a complete proprietary system of hard-wearing epoxy floor coating comprising compatible primer, hardener (as appropriate) and top sealing coat. Epoxy floor coating system shall be minimum 2.5mm thick with anti-slip grain and coved skirting and be able to withstand the designed loads/traffic with good abrasion resistance. The layer shall be impermeable to prevent infiltration of liquid into the floor in case of leakage or spillage.

(c) Type C - Heavy Duty skid-resistant coating with wearing aggregates

Shall be a complete proprietary system of hard wearing epoxy floor coating comprising compatible primer, hardener (as appropriate) and top sealing coat. Epoxy floor coating system shall be minimum 4.5mm thick with anti-slip grain and coved skirting and be able to withstand the designed loads/traffic with good abrasion resistance. The layer shall be impermeable to prevent infiltration of liquid into the floor in case of leakage or spillage.

Epoxy floor coating system shall be environment-friendly, low-odour, slip-resistant, chemical-resistant and provide a dense, seamless and dust-proofing floor surface which can be easily cleaned and maintained.

Except for plant rooms with high gloss floor finish, the top coating shall provide a light-reflective or matt surface with a wide range of standard colours for selection. Epoxy flooring shall be a low odour, low VOC, 100% solids epoxy floor coating.

Quartz epoxy flooring **21.102***

(a) Quartz epoxy flooring system

The quartz epoxy flooring shall be at least 25mm thickness of textured colored quartz epoxy flooring, with cove skirting to provide slip resistance with outstanding durability and abrasion resistance. Following performance standards shall be achieved. Other equivalent international standards are also acceptable.

Compressive Strength (**EN ISO 604**)	: > 45 N/mm²
Tensile Strength (**EN ISO 527-2**)	: > 14 N/mm²
Flexural Strength (**EN ISO 527-2**)	: > 24 N/mm²
Abrasion Resistance (**ASTM D4060**)	: < 60 mg
Hardness (**ASTM D2240**)	: > 80 Shore D
VOC Content (**ASTM D2369-07**)	: < 0.6%

(b) Quartz epoxy flooring system for carpark

The quartz epoxy flooring for carpark shall be two component penetrating epoxy primer applied to the vacuum shot blasted, or other properly prepared concrete surface.

The primer shall be cast with silica sand and allowed to cure overnight. A base coat of self-levelling epoxy of about 1mm shall be applied by trowel. While the system is still fluid, special graded quartz aggregate is broadcast onto the base coat until saturation and allowed to cure overnight. Excess aggregates are then swept off and epoxy floor coating applied to achieve the desired wear and slip resistant texture. Total system thickness shall be 2mm nominal.

Quartz shall be German quartz with high hardness to provide optimum slip resistance and abrasion resistance required in carpark. Following performance standards shall be achieved.

Thickness	: 2 mm (nominal)
Compressive Strength (**BS 6319-2**)	: 104 N/mm²
Tensile Strength (**BS 6319-7**)	: 23 N/mm²
Flexural Strength (**BS 6319-3**)	: 48 N/mm²
Bond Strength (100% concrete failure) (**BS EN 24624**)	: 4 N/mm2
Hardness, Shore D (**ASTM D 2240**)	: 82
Abrasion Resistance, Taber wt. Loss (**ASTM D-4060**)	: < 0.2 gm
Flammability, Surface spread of flame (**BS 476-7**)	: Class 1
Heat Resistance (Continuous exposure)	: 63 ˚C
Heat Resistance (Intermittent exposure)	: 95 ˚C

c) Quartz epoxy flooring system for carpark ramp

The quartz epoxy flooring for carpark ramp shall be provided with a two-component solvent free epoxy primer for deep penetration to the properly prepared concrete surface. Base coat for quartz epoxy flooring for carpark ramp shall be three-component epoxy system with especially hard, coarse aggregates applied by trowel to thickness of minimum 5mm.

The aggregates for the flooring system shall consist of 50% high quality, suitably graded aluminium oxide of natural dark brown/ black colour with no artificial coloring or coating and 50% natural quartz sands. Following performance standards shall be achieved.

Thickness	: 5mm (minimum)
Compressive Strength (**BS 6319-2**)	: 52-62 N/mm²
Tensile Strength (**BS 6319-7**)	: 8-11 N/mm²
Flexural Strength (**BS 6319-3**)	: 21-23 N/mm²
Bond Strength (100% concrete failure) (**BS EN 24624**)	: > 3N/mm2
Hardness, Shore D (**ASTM D 2240**)	: 90-95
Flammability, Surface spread of flame (**BS 476-7**)	: Class 1

Polyurethane flooring **21.103*** (a) Heavy duty Polyurethane Hybrid Flooring

Proprietary polyurethane resin floor coating system shall be trowel applied synthetic resin screed material generally complied with **BS EN 13813**.

The flooring system shall be seamless, imperious, solvent-free, moisture insensitive, lightly textured matt finish with slip-resistance of not less than R11, easy-to-maintain with excellent chemical resistance, able to withstand abrasive wear, has high impact resistance and shall withstand direct steam contact. The completed flooring shall meet Class AR 0.5 (Special) for severe abrasion resistance when tested to **BSEN 13892-4**.

(i) The flooring system shall be composed of a single layer heavy duty hybrid polyurethane cement resin binder at a minimum thickness of 6mm (with a minimum resin content of 18.5%) over a 1mm primer of heavy duty polyurethane resin cement mortar primer.

(ii) The heavy duty polyurethane resin floor finish (body coat) shall achieve the following performance properties:

Density (**BS 6319-5**)	: > 2050 kg/m³
Bond strength on concrete (**BS EN 13813**)	: > 2 MPa
Compressive strength (**BS EN 13892-2**)	: > 50 MPa
Tensile strength (**BS 6319-7**)	: ≧6 MPa
Flexural strength (**BS EN 13892-2**)	: ≧14 MPa
Impact resistance (**BS EN 13813**)	: > 4 MPa
Fire resistance (**BS EN 13501-1**)	: B fl – S1

(iii) To ensure reliability during application the system shall be substrate moisture tolerant.

(b) Polyurethane Flooring for Hardened Screed

(i) Polyurethane flooring for hardened screed shall be urethane resin based floor coating system, to provide a finished floor which is uniform in colour, tough, durable, resistant to damaging effect of chemicals, gasoline, oils and mineral spirits.

(ii) Use primer for cementitious substrate surface to improve adhesion and to reduce pinholes in the membrane. It shall be in one part, film forming primer. The primer should be stirred up and then evenly spread over the prepared substrate. The primer should be allowed to become touch-dry before the application of the floor coating.

(ii) The floor coating shall be one-part, aliphatic modified coating to provide wear, tear, chemical and UV resistance to the under laying floor substrate. The coating system shall achieve the following performance properties:

Hardness (**ASTM D2240**)	:	85 – 95 (Shore A)
Elongation (**ASTM D412**)	:	140%
Tensile Strength (**ASTM D412**)	:	2480 psi.

Weight loss (**ASTM C 957**)	:	Less than 18% loss, greater than 82% solid
Low Temperature Flexibility and Crack Bridging (**ASTM C 957**)	:	No cracks after ten cycles, -15°F and bridge a 1/18" crack
Extensibility after heat aging (**ASTM C836**)	:	Exceeds the requirement to bridge 1/4 inch crack
Accelerated Aging (**ASTM D573**)	:	No loss of elongation or tensile strength
Tear Resistance (**ASTM D 1004**)	:	95 pli
Abrasion (**ASTM C 501**)	:	0.004 (CS-17 wheel, 1000 Rev. with 1000 gram wt.)
Weathering resistance (**ASTM D622**)	:	No effect (Weatherometer 350 hours)

Traffic flooring system **21.104***

(a) Flexible polyurethane traffic deck coating shall be abrasion resistant, skid resistant and a multi-layer system comprising primer, flexible topcoat and wear course. The traffic flooring system shall be minimum 2mm thick and be able to withstand the designed traffic loads.

(b) Resin based heavy duty skid-resistant coating with wearing aggregates for vehicular ramps and driveways shall be minimum 4.5 mm thick to withstand heavy traffic loads and incorporate solvent free lightweight resin based hard wearing aggregates for providing a coloured non-slip wearing course.

(c) Traffic flooring system shall provide a flexible, seamless, watertight, UV resistant (non-yellowing) colourful hard-wearing surface and have chemical resistance to a wide range of chemicals including petrol, engine oil, brake fluid, diesel, battery acids, detergents, etc. Compatible line marking paint from the same manufacturer of traffic flooring system shall be used for traffic road mark and car park marking lines.

Anti-graffiti Coating for Fair-faced Concrete **21.105***

(a) The material shall be a Non-Sacrificial Cross Linking Co-Polymer.

(b) The material shall possess the following properties or manufacturer's latest properties

Solids Content by Volume	% >= 35
Solids Content by Weight	% <= 55
Finish	Dries Clear – Low Lust Finish
V.O.C.	Compliant to latest EPD / statutory requirement
Flash Point	Non-Flammable

(c) The material shall be 100% active with no diluting by solvent or other fluid.

(d) The product properties are listed below, or to meet the manufacturer's latest properties

Test Items	Test Method	Acceptance Standards
Water permeability of concrete	**ASTM D412**	0.006mm/min0.5
Adhesion Strength	**ASTM D412**	>20Mpa
Water Vapour Permeability	**DIN 52615**	45 x 10-12 kg/m2sPa

Water Vapour Transmission	**ASTM E96**	15.22gm/m2/24 hours
Chloride ion	**ASTM D412**	> 1.28x 10-10cm2sec-1
Thickness (Penetrate into the concrete or Screed)	/	15-25mm

Anti-septic hygienic coating system **21.106*** Anti-septic hygienic coating system shall be a proprietary system with compatible undercoat as recommended by the manufacturer applied on top of the penetration primer prior to applying the anti-septic hygienic coating.

The coating system shall be a durable, highly flexible, with high impact and scrub resistance, anti-microbial, non-toxic, low odour and high solids coating.

Solar Reflecting Paint **21.107*** Solar reflecting paint shall be provided with properties that can reduce solar gain by 85% and UV light by 90%.

Internal Textured Spray Paint **21.108*** (a) Textured spray paint coating for internal use shall consist of the following:

(i) Water-based primer coat (1 coat)

(ii) Water-based texture coat (1 coat)

OR

Water-based flat pattern (1 coat) and stone texture coat by wave spatula or pattern paper (1 coat)

(iii) Water-based silicon resin top coat (2 coats)

(b) The completed textured spray paint shall conform to the following properties when tested :

Test Items	Test Method	Acceptance Standards
Flash Point	**ASTM D65-77**	Over 105 degrees Fahrenheit, Tagliabue Closed Cup Test (TTC)
Skinning	**FED-STD-141B** (Method 6141)	No signs after 30 days
60 Specular Gloss	**ASTM D5230**	Maximum of 10
Washability	**FED-STD-141B** (Method 6141)	No more than five percent change in specular gloss and not more than 15 percent change in daylight reflectance
Flexibility	**FED-STD-141B** (Method 6221)	No cracking or checking when bent around 1/8" Mandrel
Self-Lifting	**FED-STD-141B** (Method 6252)	No evidence of lifting or blistering when relocated after eight hours
Alkali Resistance	**FED-STD-141B** (Method 6141) (Drying and aging) **ASTM D1308** (Resistance Test)	Aged film with stands ten percent sodium hydroxide for three hours
Mildew and Fungus Resistance	**FED-STD-141B** (Method 6271)	Evaluation of growth, visually no growth (organism aspergillus oryzae)
Kauri-Butanol Value	**FED-STD-141B** (Method 4352 for	For the isolated solvent, does not exceed 40

	solvent isolation) **ASTM D1133** (KB test)	

Test Items	Test Method	Acceptance Standards
Accelerated Weathering	**ASTM G23** **ASTM D822**	Excellent film integrity after 1750 hours exposure over primed substrate
Salt Spray	**ASTM B117-73**	No appreciable creepage after 500 hours exposure over primed steel substrate
Fire Safety	**ASTM E-84-61**	Class A, UL 723, Flame Spread 10; Fuel
	NFPA 255 **UBC 42-1**	Contributed 5; Smoke Developed 0.
Stain	**ASTM D-1308**	No staining from mild acids, chemicals, oils, food
Scrub ability	**FED-STD-141B** (Method 6142)	Only slight signs of wear after 7500 cycles
Bacterial Inhibition	**UU-P-510 (4.4.2.1)**	Showing a clear zone 5mm from edge of test specimen using Staphylococcus Aureus FDS #209 verifying bacteriostatic properties

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 22

PAINTING

SECTION 22
INTERNAL FITTINGS AND FIXTURES

DEMOUNTABLE PARTITIONS

Construction of the system **22.1**

The system shall be simple and strong in construction, readily adaptable to suit different office layouts and be capable of being assembled and erected with high speed and efficiency. It shall include a range of module types incorporating varying proportions of solid panels and glazed areas ranging from full height (floor to ceiling) solid panel to full height glass (including low and half height screens).

All adhesives shall comply with VOC content stipulated in the Air Pollutions Control (VOC) Regulation of Hong Kong and shall not contain the following substances regulated in Montreal Protocol on Substances that Deplete the Ozone Layer, particularly CFCs, HCFCs, 1,1,1-trichloroethane and carbon tetrachloride. The products shall contain no more than 0.01 % by wet weight of formaldehyde and no more than 0.5% by wet weight of the sum total of aromatic compounds, which include benzene, toluene, xylenes, and ethylbenzene.

All painting shall be anti-mould paints. For details of anti-mould paint, refer to Section 21 - Painting.

Partitions **22.2**

The partitions shall be fully demountable and provide maximum recovery of components including panel finishes and involve minimum amount of effort, time and disturbances of wall, floor and ceiling when alteration and resiting either in part or in whole is required. Any module shall be capable of being demounted and replaced with one of a different type or with a door.

Completed partitions shall be free from exposed bolts, nuts, nail heads and rivets. The overall thickness of a completed partition shall not be more than 100 mm.

22.2A*

a) Bi-block demountable partitions shall be proprietary re-locatable partition system comprising factory finished steel panels in powder coated finish and double-glazed panels. Internal full height partition walls in the office areas shall be of this system which was composed of an integrated system with a high degree of flexibility to permit easy re-configuration of interior spaces without disturbance to adjacent building elements. Panels including glazed panels shall be established at standard widths, which allow a high-level inter-changeability and flexibility.

b) The panels are to have a ceiling channel and floor channel. The ceiling channel shall incorporate a mechanical fixing system, which shall be compatible with the suspended ceiling system. The floor channel shall incorporate an adjustable levelling system to provide a vertical adjustable range of + or – 20mm. The floor channel fixing method shall be mechanical to ensure total stability of the system, the meeting face of the channel and floor panels shall be closed by a foam seal. Sound baffle wall above ceiling channel and/or below floor channel shall also be provided to meet acoustic requirement as appropriate.

c) The panels shall be secured together by means of a recessed feature strip. Partition vertical junction with built-in racking system capable of supporting a range of accessories.

d) Partitions shall be non-combustible and shall not give off noxious fumes in case of fire.

e) Necessary accessories are to be provided to transform the partition walls into tack boards, pin board, chalkboards, white boards, notice boards or magnetic boards.

f) The demountable partitions should be adequately protected against mechanical

damage or scratches by heavy-duty plastic sheets prior to official handover to users.

Module **22.3** The partitions shall be constructed of standard module units so assembled that individual units can be easily dismantled without disturbance to adjoining units and the partition cavity may be exposed from one face without disturbing the opposite face.

Module design of varying door heights and low level screens shall also be available in addition to the capability of the design to readily accommodate special size doors, doors with vision panels or louvers, double action doors, etc.

22.3A* Principle module shall be 1200mm wide, however, smaller modules may be required to suit site conditions. Generally, the smaller panels shall not be less than 300mm wide. A standardized power column (special panel for concealed vertical routing of conduits and for mounting of electrical switches, sockets and also A/C & other control panels) of 200mm wide minimum shall be provided next to each door of cellular offices/ rooms with demountable partitions.

Accommodation for building services items **22.4** The system shall have suitable room and sufficient provision within the thickness of the partition to accommodate normal electrical, telephone and computer network wiring and conduits, and also the related fittings including electrical switches, power points and network nodes, etc.

22.4A* Power columns shall be integrated into the wall system providing accommodation for electrical services. All the wiring works shall be concealed, running vertically within the power columns with removable covers to allow easy access to wiring. The demountable partition shall be able to accommodate control switch, electrical sockets, engage light and any building services accessories that may be required on the wall panels at any location to be specified. The necessary cable may run within the ceiling and floor channels and through the partition void. Skirting trunking shall be considered for integrated into the wall system providing accommodation for horizontal electrical services.

Approval **22.5** Any particular system proposed shall be subject to the approval of the SO, samples and details of the system shall be submitted for approval if required by the SO.

Materials

Framework **22.6** The framework shall be either galvanised and coated rolled steel sections to **BS EN 10162** or anodised extruded aluminium sections to **BS EN 515, BS EN 573-3** and **BS EN 755-1** to **9, BS EN 12020-1** and **BS EN 12020-2** or a combination of both. All sections shall be of a size and shape which shall give adequate strength to the framing. Galvanised steel sections shall be not less than 0.56 mm thick. All framework (vertical and horizontal studs and furring channels) shall have suitably placed holes formed of an appropriate size to facilitate installation of electrical and computer network and wiring.

22.6A* Extra vertical supports and braces shall be provided where heavy fixtures and cupboards are required to be hung on to the partitions.

Lining panels **22.7A*** (a) Gypsum plasterboard, Plywood or Chipboard panels

Panels shall be of 12.50 mm (minimum thickness) gypsum plasterboard or plywood or chipboard and shall be securely fixed to both sides of the partition.

(i) Gypsum plasterboard shall comply with **BS EN 520+A1** and consist of a core of set gypsum plaster in accordance with **BS EN 13279-1** and **BS EN 13279-2** sandwiched between two layers of heavy paper.

(ii) Plywood shall be Grade 2 lauan plywood for internal use as specified in Clause 13.12.

(iii) Chipboard shall comply with **BS EN 309** and **BS EN 312**.

(b) Steel panels

Panels shall be approx.. 83mm-100mm thk., faced with min. 1.0mm steel skin on each side and reinforced at the inner face of the steel skin with minimum 12.5mm plaster board and/or sheet steel in order to achieve the required acoustic requirements. The cavity shall be fully filled with min. 45kg/m^3 mineral or rock wool. The components shall be factory assembled and pre-finished with a baked-on stove enamel or polyester powder coat finish to a minimum thickness of 28 microns.

Doors **22.8** Doors shall be 45 mm thick hollow or 50 mm solid core flush doors covered with selected hardwood veneer or laminated plastic sheet on both sides and hung to rebated timber frames.

All wood panels shall be of Class E1 under **EN13986** in respect of formaldehyde emission.
The product shall not contain any heavy metals or their compounds as listed below:

(e) Arsenic
(f) Cadmium
(g) Copper
(h) Lead
(i) Mercury

The following substances shall not be added during manufacturing: elemental chlorine, fluorine, PCP (pentachlorophenol) and tar oils containing benzo(a)pyrene

The product shall have no flame retardant of polybrominated biphenyls (PBBs), polybrominated diphenyl ethers (PBDEs) or short-chain chlorinated paraffins added as formulated components.

Appropriate number and types of door hinges shall be provided depending on the size and weight of doors used.

When specified, hardwood or powder coated aluminium louvre and frame shall be fitted to the door.

22.8A* Complimentary modules shall be available at the side of door to make up the full building module for maximum ability to interchange with other panels of the same module. Vision panel(s) shall be provided when necessary.

All doors and locks on the partitions shall be integrated with the design of the partitions. The locks on the demountable partitions shall be keyed and operatable by the master key system with other doors.

Shall be installed as part of the office partition system and shall have the same acoustical performance as required for the partition wall of individual rooms. Acoustical door seals shall be provided to doors of rooms requiring additional sound-proof quality.

The components of the door frames and sub-frames shall be factory assembled and the colour should match with the partition panels.

Glass for glazed panel **22.9** Glass for glazed panel shall be 6 mm thick minimum, of the qualities specified in **BS 952**, free from bubbles, smoke vanes, air holes, scratches and other defects and cut to fit the openings, with due allowance made for expansion, and securely fixed to the trim sections by approved fixing materials and method as well as manufacturer's instructions.

22.9A* Panels shall be available solid, partially glazed or fully glazed with 6 to 10mm thick tempered glass (dependent on size of glazed panel). Glazed panels shall be fully interchangeable with solid panels or doors to the same modular dimensions.

Where glazed panel (whether full height or half glazed) is specified, it shall be double glazed modules enclosing two sheets of 6 to 10 mm clear tempered glass with a concealed PVC gasket. Each glazing element shall be factory assembled. Fritted or silk-screen patterns shall be provided for all full-glazed internal partition and full-glazed doors at appropriate levels for safety reasons.

Blinds shall be provided and incorporated in the double glazed panel configurations complete with remote control knob (to adjust the inclination of the blind) at mullion in rooms with blinds. When both module panels are locked together, the radiused vertical, mullions form a recess to house the ends of 25mm wide horizontal blinds. The head box for the blinds shall also be concealed in a recess.

Washable matt-finished vinyl cloth **22.10** Washable matt-finished vinyl cloth for panel facing shall be either plain or textured fabric-backed vinyl cloth of approved quality applied in one full width (minimum 1200 mm) to each panel with approved adhesive and as specified in Clause 22.1 prior to installation in accordance with the manufacturer's instructions. Samples with at least 5 choices of colour showing the surface texture and pattern shall be submitted for the SO's approval.

Hessian fabric **22.11** Hessian fabric shall be interior design, wall lining quality, close weave to a colour chosen by the SO fixed in full widths with approved adhesive and as specified in Clause 22.1. A sample panel shall be made up for the SO's approval before use.

Skirtings **22.12** Skirtings shall be 15-100 mm high of baked enamel steel or anodised extruded aluminium sections of minimum 1 mm thick.

Pinboards **22.13** Pinboards shall be of 13 mm softboard to comply with **BS EN 316, BS EN 622-1** and **BS EN 622-4**, finished with Hessian wall paper to be approved by the SO.

Finishings and Colours, generally Colours of finishings, anodic frame coatings, plastic stops of cover strips, together with fabrics and all other finishings shall be to the requirements of the SO.

Sound insulation **22.20** ~~Where additional sound insulation is required, a layer of 50 mm thick fibreglass quilt or plastic foam slabs of an approved proprietary brand shall be placed close butt jointed within the partition framing.~~ Detailing may vary depending on the proprietary system employed and the sound reduction factor specified. Airborne sound insulation shall be tested to **BS EN ISO 10140-1, 2 & 5** or **ASTM E413** and **ASTM E90**.

LOWER LEVEL DEMOUNTABLE PARTITION (OPEN PLAN OFFICE LAYOUTS)

Generally **22.23** The system shall be simple and strong in construction, readily adaptable to suit different office layouts and be capable of being assembled and erected with high speed and efficiency.

The system shall also be fully demountable and shall provide maximum recovery of components including panel finishes and involve minimum amount of effort, time, and disturbances on wall and floor finishes when alterations and repositioning either in part or in whole are required. Any module shall be capable of being dismantled and replaced by one of the different types of panels in the series.

Completed partitions shall be free from exposed bolts, nuts, nail heads, screws heads and rivets.

Module **22.24** The partitions shall be constructed of standard module units, so assembled that individual panel can easily be dismantled or attached at a connection point being spanned by a component without removing components from adjacent panels and without upsetting the integrity of the system.

Accommodation for building services items **22.25** The system shall have suitable room and sufficient provision to conceal within the thickness of the partitions to accommodate normal electrical, communication and computer network wiring, and also the related fittings including electrical switches, power points and network nodes, etc.

Panels frames and posts **22.26** Panels, frames and posts shall be anodised extruded aluminium sections or equivalent. All panel post sections shall be of a size and shape which shall give adequate strength to the panel framing. The aluminium frames or equivalent shall contain fastening devices to accept a variety of decorative inserts including glass panels, veneer, fabric, and acoustic materials, etc. Cut sections of panel posts shall be covered with plastic top caps and be flushed with panel tops. Joints and fixings for the panels shall be performed to produce a rigid, stable and fully demountable system.

Screen panels **22.27** The nominal thickness of the screen panels shall be within the range of 38 mm to 50 mm thick overall. Panel sizes shall vary from 1020 mm to 1650 mm high overall and shall be available in such widths that, when used in conjunction with connectors, a centreline to centreline dimension shall be 600 mm, 900 mm, 1000 mm, 1200 mm or as specified.

Screen panels shall be covered with fabric and foam layer on both sides. Centre cores shall be kiln-dried wood frames covered both sides with pinboard or plywood boarding. Each screen panel shall be finished and protected on all exposed edges with impact resistant anodised aluminium moulding or equivalent. Round corners shall be used for all exposed edges.

The tops of panels shall be suitably protected with anodised aluminium sections or equivalent against cleaning and maintenance equipment and against damages during changes.

Hanging components **22.28** Screen panels shall be designed and constructed for hanging components such as work tops, shelf units and storage components, etc. All hang-on components shall be fixed securely by a locking mechanism but can be slot-fixed into patented panel posts by support brackets or metal clips.

The screen panel assembly shall be capable of carrying a total load of 454 kg minimum.

Screen fabric **22.29** Total thickness of the fabric shall be at least 3 mm. The fabric and the foam layer shall comply with the flammability standard **BS 7176+A1** Specification for resistance to ignition or its international equivalent if polyurethane foam material is adopted. For other materials, fabric and form shall meet Class 1 rate of surface spread of flame, **BS 476: Part 7**. The fabric shall be available with a reasonable choice of colours, and shall be specially designed for covering office screens.

Wall mounted rails **22.30** Wall mounted rails shall be of metal construction with sufficient strength and shall be suitable for mounting panels to walls with connectors to ensure continuous connections and stability of the panel system.

Panel connector **22.31** The panel connector assembly shall be a single piece unit, able to connect two, three or four panels together. It shall be in metal construction and finished with anti-mould paint coating. Self adjusting mechanism shall be provided with the connector to take up any tolerance variations to ensure tight connections and to adjust to various heights of panel at each joint.

Panel connector assembly shall be designed to carry vertical load of 454 kg minimum.

Support legs **22.32** Support legs shall be bronze anodised aluminium or equivalent. Ends of support legs shall be clipped and locked securely into the bases of screen panels. They shall be adjustable for levelling without disengaging from the internal components of the screen panels.

Skirting **22.33** Skirting shall be 1.0 mm thick (minimum) anodised extruded aluminium section or equivalent. Mitred or butted corners shall not be permitted.

VENETIAN BLINDS

Generally **22.35** The materials used to manufacture venetian blinds shall comply with **BS EN 13120+A1** and shall be free from visible defects e.g. dents, scratches, etc.

Blinds shall be installed in accordance with manufacturer's instructions.

Headrail **22.36** Headrail shall be enamel coated galvanised steel section to **BS EN 10162** of sufficient strength and thickness to support the completed blind without visible sagging or twisting.

Brackets **22.37** Blinds shall be supplied with galvanised steel fixing brackets able to support the blind and retain it securely.

Slats **22.38** The blinds shall be constructed with enamel coated flexible aluminium slats of 25 mm wide and 0.18 mm thick (finished thickness) ± 5% tolerance in thickness. The material and profile of any slat in the assembled blind shall be such as to provide the strength and flexibility in accordance with **BS EN 13120+A1**.

Slat widths within a blind shall be consistent to within + 0.2 mm or - 0.5 mm. Slats shall have radiused ends or corners and shall be free from burrs and sharp edges.

Bottom rail **22.39** The bottom rail shall be constructed from enamel coated galvanised steel section to **BS EN 10162** rigid throughout its length in the mounted blind. The ends of the bottom rail shall be enclosed with plastic end-caps.

Ladder tapes/cords **22.40** Ladder tapes or cords shall be constructed from polyester fibre.

STRONGROOM DOORS

Generally **22.50** Strongroom doors are classified as follows:

Treasury Grade A	shall be as specified and comply with Director of Accounting Services requirements.
Treasury Grade B	shall be as specified and comply with Director of Accounting Services requirements.
Treasury Grade C	tough steel door with 25 mm thick door plate.
Treasury Grade D	tough steel door with 10 mm thick door plate.
Treasury Grade E	tough steel door with 8 mm thick door plate.

22.50A* **High Security Doors**

To be constructed of grade 316 stainless steel section or GMS section with factory finished powder coating (all steel frames to be in 16 gauge GMS and securely fixed with lock in anchor system or approved similar) designed for high security areas or any other rooms where specified.

Strong rooms shall be provided with doors of appropriate Treasury Grade complete with 3-wheel combination locks or products having equivalent functions or performance.

Treasury Grade C door

Door **22.51** The door shall have an overall thickness of 157 mm, of which the outer door plate to be 25 mm thick tough steel. The door plate of solid steel shall be further reinforced over the locks and vital parts. The lock and essential parts of the

boltwork shall be protected by hardened steel plate to give overall metal protection of 38 mm thick.

Door frame **22.52** Door frame shall be made from substantial angles at the sides and top with a flat frame at the bottom. The frame shall be welded to form a complete structure of uniform strength. For securing the frame into the wall, three pairs of grip lugs shall be provided to suit a minimum wall thickness of 225 mm. The door shall be hung in the frame by hardened steel pivots working in steel carriages. Vertical thrust from the door shall be taken on a hardened steel ball bearing, vertical adjustment shall be provided.

Boltwork **22.53** There shall be six solid steel bolts at the front edge with six fixed dog bolts on the back edge of the door. All these bolts shall be 38 mm in diameter. The moving bolts and fixed dog bolts shall be engaged behind the solid rebates of the frame.

Locking **22.54** The lever-operated bolts throwing mechanism shall be secured by a 7-lever lock with monitor action to ensure that the door is always properly locked. The door shall also be fitted with a three wheel keyless combination lock to ensure maximum security. All locks shall be protected by a drill resistant plate.

Explosive protection **22.55** Anti-explosive protection devices shall be provided, which shall be designed to automatically re-lock the door if an attempt is made to dislodge the lock by explosive or other means.

Fire protection **22.56** A steel panel of 44 mm overall thickness incorporating proven fire resisting materials shall be fitted over the whole area of the lock chamber.

Treasury Grade D door

Door **22.57** The door shall have an overall thickness of 135 mm, of which the outer door plate to be 10 mm tough steel. The door plate of solid steel shall be further reinforced over the locks and vital parts. The lock and essential parts of the boltwork shall be protected by hardened steel plate.

Door frame **22.58** Door frame shall be made from 75 x 75 mm steel angles at the sides and top with a 10 mm flat steel frame at the bottom. The frame is welded to form a complete structure of uniform strength. For securing the frame into the wall, three pairs of grip lugs shall be provided to suit a minimum wall thickness of 225 mm. The door shall be hung in the frame by hardened steel pivots working in steel carriages. Vertical thrust from the door shall be taken on a hardened steel ball bearing, vertical adjustment shall be provided.

Boltwork **22.59** There shall be six 25 mm diameter solid steel sliding bolts engaged behind the 25 mm square rebate of the door frame. The edge of the door shall be hinged with a 40 mm x 20 mm full door height bar engaged behind the solid rebates of the frame.

Locking **22.60** The lever-operated bolts throwing mechanism shall be secured by a 6-lever lock with monitor action to ensure that the door is always properly locked. The door shall also be fitted with a three wheel keyless combination lock to ensure maximum security. All locks shall be protected by a drill resistant plate.

Explosive protection **22.61** Anti-explosive protection devices shall be as Clause 22.55.

Fire protection **22.62** A steel panel of 44 mm overall thickness incorporating proven fire resisting materials shall be fitted over the whole area of the lock chamber.

Treasury Grade E door

Door **22.63** The door shall have an overall thickness of 108 mm, of which the outer door plate to be 8 mm tough steel. The door plate shall be further reinforced over the locks and vital parts. The lock and essential parts of the boltwork shall be protected by hardened steel plate.

Door frame **22.64** Door frame shall be as Clause 22.58.

Boltwork **22.65** Four 25 mm diameter solid steel moving bolts shall be fixed at the front edge and four fixed bolts shall be engaged behind the 25 mm square rebate of the door frame.

Locking **22.66** The bolt-throwing mechanism shall be operated by a lever handle which shall be secured by a 6-lever lock or a three-wheel keyless combination lock as specified.

Explosive protection **22.67** Explosive protection shall be as Clause 22.55.

Fire protection **22.68** Fire protection of the strongroom door shall be as Clause 22.62.

LOCKERS

Compartments **22.71** ~~Multi-tier lockers shall comprise a maximum of six-tier compartments and shall not be more than 2000 mm in overall height including the supporting frame or base.~~

Stacks of lockers may be connected together to form a block.

Material and construction **22.72** ~~Sides, back and shelves of locker shall be manufactured from 24 SWG cold rolled galvanised steel sheet, jointed together to form the locker housing.~~

~~Door frames shall be manufactured from 20 SWG cold rolled galvanised steel sheets.~~

~~Doors and reinforced ribs shall be manufactured from 24 SWG cold rolled galvanised steel sheet. Doors shall be reinforced top and bottom with vertical rib for rigidity and security; and shall be mounted in a formed framework to the front of the locker housing.~~

All components shall be finished with baked enamel of colour as specified prior to final assembly.

22.72A* (a) Unless otherwise specified, lockers shall be of two-tier compartments design installed on 100mm high concrete plinth with homogenous tile finish.

(b) Proprietary locker system shall consist of continuous anodized aluminium structural profile with full height extruded channels for insertion of dividing panels, back and end panels, top and bottom panels, shelfs and support units, door panels with concealed stainless steel self-closing hinge and built-in door silencer for absorbing impact and noise when door closing, built-in coat hook and hanger rail, partially open shoe rack, numbering plate, individual cam locks or padlock device for each door, etc.

(c) All panels shall be matt finished double-sided decorative Compact Grade laminates with improved fire retardance (type CGF) complying with **BS EN 438-4** and of adequate thickness to perform the functional requirement.

Door fittings **22.73** Doors shall be fixed with door buffers for quietness. Door hinges shall be concealed self-closing type. PVC number plate with engraved numbers shall be fixed on each door.

Ventilation **22.74** Lockers shall be designed to allow free internal air circulation using perforated door and/or back panel, without impairing the security of locker compartments.

Safety **22.75** Lockers shall be free from any sharp points, edges and corners.

Door lock **22.76** Door lock may be one of the following:

(a) Cylinder spring bolt lock with large cylinder and 2 keys.

(b) Cylinder refund locks with detachable lockset, entirely made of stainless steel, controlled by master key.

The lock mechanism shall be securely protected to interlock with the frame upright.

CUBICLE SYSTEMS

Cubicle systems generally

22.77 Cubicle system shall comprise of pilaster panel, division panel, door and lock system, ledge wall if applicable, and the associated works in the installation of the system inclusive of all components, fixings, ledge wall behind sanitary fixtures if applicable, and ironmongery necessary for the erection of the works.

Cubicle systems to consist of panels with light weight core material and high-performance surface veneer which shall be impervious to water, easily cleaned and with a durable finish.

Panels shall be designed to be bolted or screwed together and may be raised on posts or wall brackets above floor level, floor mounted, or suspended from above.

Toilet cubicle partition and back panel system

22.77A* (a) Proprietary toilet cubicle partition system shall have no top rail for anti-suicide design. The cubicle system shall complete with all the necessary hardware and anti-corrosion grade 304 satin stainless steel ironmongeries including but not limited to thumb-turn lock with occupancy indicator and coin release, self-closing and soft-closing hinges, angle brackets, adjustable foots, etc. Emergency opening device shall be incorporated in the design to allow the locked door to be opened outward or lifted in case the normal inward-opening action is obstructed.

(b) Back panel system shall be proprietary product fully integrated with complete metal frames and fitting systems of the same manufacturer.

All sub-frames, spacers, clips and panels shall be delivered as a complete system. Site frames and sub-frames of the back panel system shall be manufactured from extruded aluminium sections and rolled galvanized steel sections with steel bracing board respectively.

Sub-frame shall be installed within aluminium site frame by click-fix nylon location brackets. Back panels shall be fixed to steel section by bright zinc plated mild steel brackets joggle clips.

(c) All panels of toilet cubicle partition and back panel system shall be scratch resistant matt finished double-sided decorative Compact Grade laminates with improved fire a (type CGF) complying with **BS EN 438-4** and of adequate thickness to perform the functional requirement. The panels and assemblies shall be capable of adequately supporting the weight of sanitary fittings together with a minimum static load of 150kg applied to each fitting.

Back Panel System for all Toilets Cubicles and Wash Hand Basin

22.77B* Back Panel System shall be proprietary products together with the complete proprietary metal frames and fitting systems of the same manufacturer, complying with the following requirements and shall be installed at locations as appropriate or otherwise specified.

(a) Back Panel System shall be used behind all sanitary fittings of toilet cubicles. They shall comply with Health Technical Memorandum (**HTM 64 & 68**). The panels and assemblies shall be capable of adequately supporting the weight of sanitary fittings together with a minimum live load of 140kg applied to each fitting.

(b) All sub-frames, spacers, clips and panels shall be delivered as a complete system.

(c) Site frames and sub-frames of Back Panel System shall be manufactured from extruded aluminium section and rolled galvanized steel section with steel bracing board respectively. Sub-frame installed within aluminium site frame by click-fix nylon location brackets. Back panels fixed to steel section by bright zinc plated mild steel brackets joggle clips.

(d) All Back Panel System shall be of approved colors. Full spectrum of colors shall be available for selection.

(e) Back Panel System for all wash hand basins shall be provided with proprietary integral satin anodized skirting.

Construction and Material

22.78 Panels, doors, pilasters, ledge walls and vanity top of cubicle system shall be either:

(a) Metal construction of baked enamel or vinyl finish constructed with hot-dipped galvanised steel sheets formed and bonded with a cellular honeycomb core, or polyurethane core, or other approved light weight core materials. Edges shall be tack welded around the perimeter and sealed with interlocking moulding. Moulding corners shall be welded to each other and to face sheets and ground smooth to form a rigid frame around the component.

(b) Plastic construction fabricated of high pressure laminate on cores of particle board or plywood. Composition core shall be multi-ply to resist warping and assure surface smoothness. Face laminate shall overlap edge laminate to assure water run-off and enhance adhesive bonding.

(c) Solid Laminate or phenolic panel of min. 12 mm thick for all components and complied with **BS EN 438**.

Doors and panels supplied under sub paragraphs (a) and (b) above shall be completely moisture resistant and 20 mm thick (minimum) and pilasters shall be 32 mm thick (minimum).

Colour, pattern, and texture of decorative surfaces shall be approved by the SO. Full spectrum of colour, pattern and texture shall be available for the SO's selection.

Cubicle rail system

22.78A* (a) Cubical rail system shall be proprietary product incorporating fixed and lateral movable cubicle curtain tracks suspended from ceiling with hangers, wall brackets, fittings, roller gliders and accessories for hanging of bed curtains. All fittings shall be designed, constructed and tested to the requirements of **HTM 66**.

(b) The system shall be manufactured from anodized aluminium in satin finish and shall include premium grade nylon components. The track system shall consist of a fixing support attached to the rear wall and anchored, using fasteners appropriate to the wall condition. Rail splices shall be accomplished using a connecting bridge which is secured to each rail section by screws from above. The top channel shall maximize connection positions and suspension variations and shall be provided with a dust cover to reduce the risk of infection. Track suspension shall be through the use of a hanger rod attached to the structural ceiling, or where applicable, extending through the suspended ceiling by the use of a threaded sleeve and threaded stud. Timber noggins shall be used when required to provide a firm attachment.

(c) The carrier shall attach directly to the underside of the suspended ceiling or to the integrated suspended ceiling and whenever applicable, the track shall be centred on the ceiling tile grid. In locations where it is necessary to install track across spans of ceiling tile, timber blocking shall be installed above the ceiling to receive the fasteners. Blocking shall extend 150mm on either side of the track.

(d) All exposed track ends shall be closed with a matching end cover. Pop-out safety glider hooks shall be capable of 360 degree rotation and shall be provided in quantities of 10 nos. per meter. Glider hooks shall be designed to prevent binding and accidental curtain removal.

(e) Track bend shall be factory fabricated as a single piece with minimum 250mm radius, without deforming track section or impeding movement of carriers. Overlapping joint linking bend with front track shall be available. Wand made of aluminium hollow section shall be attached to lead carrier for pull-to-close/open action.

(f) For specific use in high-risk areas to reduce the risk of self-harm as required by users, proprietary safety devices for hangers and wall supports shall be provided to ensure the track will be separated when a maximum load of 40kg is applied at any point of the cubicle track.

Shower doors

22.78B* Shower door shall be proprietary full height shower door manufactured from the same source as an optional item for selection. The full height shower door shall be easily installed using the fixing kit supplied and shall be able to hold securely in place with locking screws and with earth bonding facilities included.

The full height shower door shall :

(a) have a pivot action and 90° open inward frame door to allow it fold inside, or against the supporting wall, to leave valuable floor space clear when not in use

(b) have improved drainage provided by offset doors containing aluminium section water deflectors and round sleeve wiper blades

(c) have minimum 6mm thick tempered glass **BS6206** panels encased in a white polyester finished aluminium alloy framework

(d) be strongly magnetized door closer strips create a secure seal at the door opening

(e) have outward opening doors allow maximum use of showering area

(f) have 13mm rise and fall hinge with wiper blade ensures maximum seal between door and tray

(g) have door knob and door handle

(h) have panel seals protected by anti-fungal and anti-bacterial white gasket

(i) have fixed panel height of not less than 1900mm

Door fittings **22.79** Doors shall be fixed with stainless steel or chromium-plated self-closing hinges which shall be adjustable to allow the door to open to different degrees.

Door latch shall be slide latch indicator bolt or concealed latch knob with indicator, or other proprietary product approved by the SO. Locking devices shall have emergency release mechanism.

Buffer hook also serving as clothes hook shall be fixed to each door.

Door stop and door keeper with full height rubber strip shall be fixed to the lock side of the pilaster.

All stainless steel ironmongeries shall be Grade 316. The ironmongeries shall include door hinges, thumb turn bolt with engaging indicator, coat hook with buffer and door stopper.

Fixing of cubicle systems **22.80** Cubicle system may be floor supported, wall mounted, overhead braced or ceiling hung. Overhead braced compartments shall be braced with anti-grip headrail.

Panels and headrails shall be screw-fixed to wall and pilaster with stainless steel brackets or aluminium channels.

Edges of pilaster shall be screw-fixed to wall with stainless steel brackets or aluminium channels.

Ceiling mounted pilaster shall be fixed to the overhead structural members by means of stainless steel inverted stirrup brackets and adjustable threaded stud and shall be covered with stainless steel plinth or other approved coverings.

Base of pilaster shall be screw-fixed to the floor by means of stainless steel inverted stirrup brackets with adjusting devices for levelling during installation and permanent height adjustment of the partitions. Connection between base of pilaster and floor shall be covered with stainless steel plinth or other approved coverings.

The fixings shall include adjustable foots for floor levelling, angle brackets and panel holder on the recessed aluminium powder coated head rail system. All stainless steel fixings shall be Grade 316.

FOLDING/SLIDING PARTITIONS

Folding Partitions generally **22.81** Partitions shall be continuously hinged and suspended with swivel hanger either at the end of alternating panels or centrally hung for all panels of a maximum height of 4500 mm. Tracks or guides, where used shall be flush with the floor finish and all ironmongery fittings are to have matched finishes.

Sliding folding partitions

22.81A* (a) The sliding folding partition system including the partition panel and the sound baffle wall above the ceiling tracks, shall achieve a sound reduction of 45dB or as specified in Room Data Sheet. The first and last panel shall be connected to the wall by balloon seal and telescopic panel to maintain the integrity of its acoustic performance. Each line of panels shall include a proprietary passing door, with clear door width of min. 850mm and clear door height of min. 2050mm. The passing door shall include all proprietary ironmongeries, knocks, handles and hinges. The locks on the passing door shall be master-keyed together with other locks in the building.

(b) There shall be provisions of recesses in the wall or provisions of cabinets to conceal the sliding folding partition when fully folded open.

(c) Partition panels shall be of clear anodized 6063-T6 aluminium framing with galvanized steel faces laminated to the acoustic particle or gypsum board and finished with plastic laminate or in matching wall finishes with the rooms they are located in or as stated in the Room Data Sheet. Full height double glazed sliding folding partitions with fritted pattern and integrated with adjustable blinds for privacy control shall be provided for the conference / meeting room.

(d) Full height double glazed folding sliding partitions with fritted pattern and integrated with adjustable blinds for privacy control shall be provided for conference rooms and meeting rooms.

Panels **22.82** Panel construction shall be either:

(a) 45 mm thick (minimum) and not exceeding 900 mm in width for end hung partitions or not exceeding 1200 mm for centrally hung partitions, consisting of hardwood frame and selected hardwood edging with plywood facing finished with either veneers, plastic laminate, vinyl cloth or anti-mould paint as specified. When specified, panels shall be infilled with mineral wool.

(b) Proprietary partition panels of aluminium or steel framing with particle board or steel faces. Thickness, width and height of panels shall be in accordance with manufacturer's recommendations.

Vertical seals **22.83** Vertical sound seals between panels shall be tongue and groove configuration incorporated with vinyl acoustical seals.

Horizontal seals as generally **22.84** Horizontal seals, both top and bottom shall be twin-finger contact type vinyl strips sweep seals fixed to the top and bottom edges of the panels.

Pass doors **22.85** Pass door shall be either a swing access door of a maximum height of 3000 mm, provided by the end leaf of a hinged unit consisting of an odd number of leaves or an independently hung leaf.

Alternatively, pass doors can be wicket doors required no thresholds and finish to match the partition panels.

Pass doors shall be fixed with stainless steel hinges and furnished with mortice latches with flush lever handles on both sides of the doors.

Suspension system **22.86** Suspension system shall consist of heavy duty extruded aluminium or hot-dipped galvanised steel track to **BS EN 10143** connected to the structural support by bolts or threaded rods.

Brackets shall be aluminium alloy pressure died castings or other approved bracket types, spaced at centres not exceeding 900 mm and shall be reduced to 600 mm centres for heavy doors.

Hangers shall be steel ball bearing type (lubricated for life) or proprietary trolley assembly: both shall be with vertical adjustment.

Panels shall be continuously hinged with stainless steel butt hinges fitted 3 in height on partition up to 3000 mm.

PARTITION SYSTEM

Solid dry wall partition system **22.87*** Proprietary solid drywall partition system shall be composed of light gauge metal framework (metal furring channels, studs, etc.). The drywall partition shall be lined with fibre-cement sheet and ready for receiving specified finishes, in-filled with lightweight concrete core mix, jointed using approved paper or fibre-glass gauze tape and cementitious jointing compound. The dry wall system shall be tested in accordance with **BS5234-2** and fully complied with the requirements of **Severe Duty (SD)** grade. All proprietary solid drywall partition to be adopted in quarter units should be able to bear minimum 1kPa elevation loading capacity for future built-in furniture or hanging objects like hanging cabinet and wall mounted television set at living room, floor and hanging cabinet/ at kitchen and bathroom and built-in wardrobe for all bedrooms. A metal sub-frame, if necessary, can be provided and installed inside the drywall system.

(a) Metal framework shall be light gauge metal studs and channels of cold rolled, hot dip galvanized steel to **BS 7364** and in accordance with the fire rating requirements: -

(i) Stud shall be C-shaped lipped studs of 64mm, 92mm or 150mm deep and 32mm minimum wide and 0.8mm minimum gauge and with a steel grade minimum of 200MPa; and

(ii) Top and Bottom track shall be returned flange U-shaped section having web depth compatible with those of the studs and of the same nominal size and 0.8mm minimum gauge and with a steel grade minimum of 200MPa.

(b) Fibre-cement sheet shall be of nominal thickness 6.6mm and be tough and strong to resist the significant hydrostatic and impact stresses resulting from the core filling.

(c) Sheet fixing screws shall be self embedding countersunk head winged screws of 25mm long and 8mm nominal head size in accordance with specification and recommendation of the manufacturer.

(d) Core mix in-fill shall be lightweight concrete of fresh density of 750-850kg/m3 in accordance with specification and recommendation of the manufacturer and as required by the fire rating and acoustic requirements.

(e) Jointing materials shall be cementitious jointing compound with appropriate reinforcement as per the manufacturer's specification and recommendations. Proprietary joint reinforcement shall be:

(i) Either perforated paper jointing tape or fiberglass self-adhesive gauze tape for internal corners, recessed joints, and butt joints; and

(ii) Galvanized steel or PVC corner angles for external corners.

Half-glazed and full-glazed internal partitions **22.88***

(a) Half-glazed and full-glazed internal partition walls shall be composed of concealed supporting frame and intermediate fixing rails of galvanized steel sections, extruded aluminium sections and glass sub-frame in powder coat finish, clear laminated safety glass to **BS EN ISO 12543-2** with appropriate thickness commensurate with the panel size and min. 12mm thick proprietary anti-bacterial high pressure compact laminate phenolic panels of flame-retardant grade type CGF to **EN 438-4**. Access panels shall be provided for maintenance of concealed services such as plumbing and drainage pipes for wash hand basins.

(b) Fritted or silk-screen patterns shall be provided for all full-glazed internal partition and full-glazed doors at appropriate levels for safety reasons.

(c) For specified location (e.g. Children's Play Room), vision glass panels of good transparency and non-reflective nature for visual contact / monitoring shall be provided. Those glass panels shall be integrated as part of the drywall system and shall be of non-tinted, low-reflectance, tempered laminated glass, vandal-proof, water-clear and moisture resistant and with proper sound insulation properties. Proper ceramic dot pattern or in-glass printing would be required as visual warning and display information.

Double glazed partition with internal blind integrated (inside cavity) **22.89***

Proprietary double glazed partition panel shall be composed of extruded aluminium frame in power coat finish and two sheets clear laminated safety glass with appropriate thickness commensurate with the panel size.

Each laminated glass sheet shall be housed in an aluminium frame with concealed PVC gasket and factory assembled. Built-in integral venetian blind shall complete with control knobs at both sides of mullion to adjust the inclination of the blind. All assemblies of the blind including head rail, mounting bracket, head cap, control cable, bottom rail and other accessories shall be concealed in the double glazed panel.

Acoustic wall panel **22.90***

(a) Shall be 16mm thick acoustic panel made of Medium Density Fiberboard (MDF) and finished with wood veneer in matt or semi-gloss varnishes (proprietary from the same manufacturer) and a decorative groove pattern and backing with perforated pattern and acoustic black fleece for appropriate sound absorption and diffusion performance to compliment with the interior design.

(b) MDF board used shall comply with E1 formaldehyde emission limit of less than 8mg/100g when tested in accordance with **EN 120**. Certificate to demonstrate compliance shall be submitted.

(c) The acoustic wall panels shall be fixed with wood batten and minimum 50mm thick glass wool in-fills of 40kg/m3 density. The acoustic panel shall feature with tongue and groove joints to allow mounting the panels as a joint-free continuous wall. The fire performance of acoustic wall panel shall be classification B or above in accordance with **BS EN 13501-1**.

(d) Acoustic panel shall comply to **BS 476-6 & BS 476-7** Class I Fire Test Certificate to demonstrate compliance shall be submitted.

Wall padding (general use) **22.91***

Padded wall panels shall consist of minimum 50mm thick polyurethane foam adhesive fixed to 12mm thick fire retardant plywood. The foam surface shall be covered with minimum 14oz. tear resistant vinyl fabric. The fabric shall be folded and stapled securely to the back of the plywood backer board. Top and bottom of panels shall have 25mm nailing margin to secure the panels to the primary wall system.

Final trim pieces concealing the main attachment screws shall be attached in a fully tamperproof manner and not removable except through the use of special tools. The vinyl material shall be treated so as to be anti-bacterial and fungi resistant and to be mildew and rot proof and shall be fire-rated as self extinguishing. The fire performance of wall padding shall be classification B or above in accordance with **BS EN 13501-1**.

Composite wall padding system (for disturbed patient room) **22.92***

The system shall consist of a layer of elastomeric foam backing adhesive fixed to an 18m thick fire resistant backing together with a final layer of acoustic, non-toxic vinyl sheet wall cladding utilizing cold welded seams at all edges and intersection with the integral cove base of the cushioned vinyl flooring system.

The foam backing shall be closed cell elastomeric foam of minimum 20mm thick, provided in maximum available panel widths to assure a continuous substrate designed for high duty applications. Finished installation shall be suitable for application cold welded sheet vinyl. Acoustic vinyl sheet lining shall be tough, flexible and durable, minimum 2mm thick, homogeneous and monolayer with polyurethane surface treatment.

The wall padding system shall extend from floor to finished ceiling including door and door frame. All final trim pieces at the ceiling intersection shall be attached with tamper-proof screws requiring special tools for removal. Top, bottom and both sides of each backing panel shall be fabricated with a 25mm accessible border for secure attachment using tamper proof screws requiring special tools for removal. Both the foam backing and the vinyl shall extend over this border for final welding of adjacent panels. The fire performance of composite wall padding system shall be classification B or above in accordance with **BS EN 13501-1**.

Material to be applied at door frames and inside face of entry door over elastomeric foam backing as described above and at floors according to manufacturer's recommendations. Seams are to be cold welded. Provide coved base with heat welded seams between flooring material and wall panels.

Composite decorative panel / lattice with imitation wood finish **22.93***

(a) Shall be a composite material created by combining vegetable based and synthetic resins with crushed almond shells. The panels / lattice shall be standard proprietary product or with customized design to match with the interior design concept. The panels could be applied to both wall and ceiling.

(b) The requirements of the panel / lattice:

(i) Achieve the required fire resistance performance in accordance with **UNE EN ISO 11925-2** and **UNE EN 13823**

(ii) Abrasion resistance not less than 575 in accordance with **UNE 56842** standard

(iii) Good Impact resistance in accordance with **UNE 56867**

(iv) Color Fastness not less than 5 in accordance with **UNE 53464**

(v) Tensile strength not less 8'99N/mm^2 in accordance with **ISO 527**

(vi) Excellent resistance to chemicals and stains in accordance with **UN 53464**

Acoustic Operable Partition System **22.94***

General

(a) Semi-automatic operable partition system shall include support frame, sliding tracks, sound baffles, control switch and all necessary ironmongeries.

(b) The operable wall systems shall generally be from an internationally recognised source with **ISO 9001** certification, in continuing production and of consistent design and finish.

(c) The operable partition system shall achieve a long-term sound insulation between adjacent spaces of the partitioned compartments of minimum STC 51 as accessed in accordance with **ASTM E90** "Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions".

(d) The selection of sound insulating movable wall systems shall reflect the use(s) and quality of the project with ease of installation and operation and be able to divide a certain interior into acoustically separate compartments in a reasonable period of time.

(e) The fire resistant performance of the acoustic movable partition wall assemblies shall be in accordance with **BS 476-22**.

Automatic Functions

(a) As the partition is opened and closed, the telescopic panel and the horizontal seals (sealing strips) of the individual panels must be extended and retracted by electric motor. The power supply is conducted from panel to panel via end-face plug contacts and a system connection to the mains supply via a plug-in power supply unit and a central master switch. Protective function shall be provided by electronic overload relays. For safety reasons, mechanical limit switches are not permitted.

(b) In order to ensure functional efficiency even in the event of a malfunction or fault (power failure) an emergency unlocking device shall be provided for all system components.

System Components

(a) Standard Panels

(i) The panels shall be of nominally 800- 1250mm width.

(ii) The panels shall be minimum 100mm thick with a minimum average surface weight of 50kg/m2 with a frame construction of torsionally stiff aluminium and steel tubular sections. The operable partition system shall provide a laboratory test of sound insulation in Rw value of 50 dB, consisting of individual panels constructed with constructed with 16mm free-oscillating MDF board on both sides and incorporating mechanical operated top and bottom retractable sound seals of contact pressure at 1500 Newton each element, suspended at two points by multi-directional steel ball-rollers. All aluminium sides trims shall be of natural anodize incorporating interpolating magnetic strips of vertical strength at 40 Newton per run and vinyl finish seals.

(iii) The surface finish of the panels shall be high-quality laminate with melamine resin surface of parchment structure - RM (raw) in accordance with **EN 438-2**.

(b) Panel Connection

The panels shall be interconnected by means of a positively and frictionally retained interlocking concave/convex sheathed aluminium profiles with an integrated magnetic strip having a linear attraction of min. 40 N/m. Metal components shall be invisible when partition both open and closed. Additional vertical outboard shall seal at panel abutment joint.

(c) Panel Adjustment

In order to compensate for any small degree of ceiling sag, each panel shall be adjustable without the need to open up the ceiling cavity or the panel itself. In the event of superficial damage, it shall be able to replace the facing panels without removing or dismantling the panels or other components of the construction.

(d) Overhead Suspension System

(i) Each panel shall be hung at two points from a ceiling-mounted track of aluminium and operate on maintenance-free multi-directional carriers featuring track rollers mounted in ball bearings. The carriers shall be secured to the panels by means of shock-absorbing/impact-damping rod elements. There shall be no ball races or sliding friction pads/discs.

(ii) Track systems shall be secured by means of adjustable steel or aluminium suspension sub-frame to load-bearing structural components except floor slabs. Rigid, non-adjustable hanger constructions are not permitted. The structural steel sub-frame for shall be designed, tested, fabricated and installed in accordance with GS Section 15.

(iii) The track shall incorporate anti-twisting lateral tolerance feature. Track design shall provide integral support for adjoining ceiling, soffit, or plenum sound barrier.

(iv) Transfer track shall be provided as required. Only T-track is allowed for aluminium tracks.

(v) The materials employed must be provided with a corrosion-inhibiting coating/treatment.

(vi) The track must be absolutely maintenance-free. Intersections, T-junctions and corner elements must be closed-die forgings and equipped with support roller assemblies. In order to ensure the easy operability of the elements, including at track junctions and in the stacking/parking area, rolling friction must be ensured at all points along the track.

(vii) The overhead aluminium track shall be natural anodized architectural-grade aluminium alloy 6063-T6. Track connector shall incorporate alignment pins for positive alignment, shall be unitized for optimum sound control, and have integral support for adjoining ceiling, soffit, or plenum sound barrier.

(viii) Track intersections must be designed and constructed to enable smooth operation. They shall be made of the same grade of architectural-grade extruded aluminium as the regular track without variation in texture and colour.

(ix) All tracks and carriers should be load tested for a minimum of 100 miles. Tracks and carriers that have not been tested to that extend shall be rejected.

(x) Carrier shall be of heavy duty multidirectional-steel roller (R-roller) carrier and equip with minimum 4 stainless steel ball bearing wheels to take a panel weight of maximum 200kg per roller. For panel height more than 7m, carrier shall be of heavy duty unidirectional-steel roller (SR-roller) carrier and equip with minimum 4 heavy-duty stainless steel ball bearing wheels to take a panel weight of maximum 1000kg per roller.

(e) Telescopic Panel

(i) The final closing panel of the partition system shall be designed as a flush- closing telescopic compensation panel without protruding or receding edges. Its function must be ensured over its full height by means of a triple- action, electrically powered spindle/lever drive mechanism. Construction elements such as folding flaps are not permitted.

(ii) The compensating component shall be constructed from 16 mm thick three- ply high-quality particle boards with an El rating per **DIN** standards. The construction and material of the telescopic panel shall be identical with that of the typical panels. The telescopic panel shall have similar and effective top and bottom seals.

(iii) A useful extension stroke of up to 120 mm must be available in order to ensure flush-closing of the partition, and the contact pressure must be adjustable between 0 and 1000 N.

(f) Sound Baffle

(i) Ceiling bulkheads as sound baffle shall be provided to prevent flanking. Unless otherwise specified, the bulkheads shall be constructed with 2 layers (staggered joints) of 12.5mm gypsum boards on each side and it shall be insulated with min 50mm layer of rockwool insulation of 50kg/m3 density.

(ii) Barrier/penetration seals shall be provided for all building services penetrating the bulkheads to prevent acoustical flanking transmission.

(iii) A double-skin sound baffle (attenuation up to Rw = 48 dB) or a quad-skin sound baffle (attenuation Rw = 49 dB to Rw = 55 dB) or six-skin sound baffle (Rw = 57 dB) shall be provided to correspond to the specified sound reduction value of the partition elements. A clean, tight seal against the head track and adjacent building parts must be ensured. The cavities between the plasterboard skins must be filled with non-settling mineral wool. The ceiling joints must be sealed with silicone mastic filler (permanently elastic type).

(g) Retractable Seals

(i) Top and floor seals shall be electrically activated with manual override to seal the panel sound-tight with respect to the track and floor.

(ii) The 4 corner blocks at each comer of the panel shall be activated to close gap between joining stile at top and bottom of each panel.

(iii) The floor seal shall incorporate a compensation system to accommodate panel clearance of 35mm with respect to the floor and any changes in clearance due to structural deflection. The compensation system shall have a contact pressure of 800N between the panel and the structure floor. All top and floor seals shall be out of contact with the respective surface during movements of the panels. Vertical magnetic seals must be included and perform acoustically matching and sound tight between panels.

(iv) The vertical seal shall be based on a tongued and grooved principle to ensure optimum sealing with vertical magnetic strip to provide a force of up to 40 N/m with acoustical labyrinth minimum 40mm.

(v) All seals shall be activated both electrically and manually. In case of power failure or any other emergency the panels and seals can be operated manually.

(h) Parking Niche Doors

(i) Parking niche doors shall be obtained from the same source as the operable wall. They shall be constructed of 50 x 40mm galvanised steel section welded to form a sturdy framework, with intermediate rails < = 1000mm centres and with a minimum of 2 nos. supporting brackets 30 x 30 x 2mm at each section of the door framework for the fixing of the facing board. Provisions shall be made to receive the espagnolette bolt at the back of the door.

(ii) Doors shall be faced one side with gypsum board or plywood and finished to match the adjoining wall decoration.

(iii) Door frame shall be made from 50 x 40mm galvanised steel section with proper anchors to the adjacent wall.

(i) Ironmongery for Parking Niche Doors

(i) Stainless steel heavy duty ball bearing butt hinges 115 x 100 x 3.4mm (2 hinges per door leaf up to 1800mm high with an extra hinge at every 450mm height increment) shall be used for the parking niche doors.

(ii) Galvanised steel espagnolette bolt 26(W) x 119(H) x 14(T) mm with 15mm barrel projection complete with top and bottom rods to suit the door height shall be used for locking. Top keep and bottom socket shall be incorporated for securing the door leaf.

(j) Acoustic Performance

(i) Acoustic performance shall be tested at a laboratory in accordance with **DIN EN 20 140-3**.

(ii) Standard panel construction shall have obtained a Sound Transmission Classification (STC) rating of 51dB.

(iii) Complete and unaltered written test report shall be made available upon request.

(k) Power Supply

Power Supply shall be 230V(50/60Hz, 120VA) and shall be provided above ceiling for the semi-automatic transformer. Additional transformers shall be required depending on quantity of panels in each run of operable partition system.

Quality Assurance

The following standards shall be complied with:

(a) Fire hazard classification: **ASTM E84**

(b) Sound Transmission classification: **DIN EN 20 140-3**

(c) Noise isolation classification: **ASTM E336, ASTM E413**

(d) Design and construction of surrounding conditions shall be as per **ASTM E556**

(e) The System shall be from an internationally recognized source with **ISO 9001** certification.

Movable Partition **22.95*** **Panel Construction**

(a) Provide panels fabricated with panel surfaces of 1 mm (20 gauge) steel resiliently secured to (2 mm) 14 gauge steel tubular frames with appropriate insulation to achieve specified Sound Transmission Class (STC) 55. Provide panels of not less than 100mm thickness and weight of minimum 50 kg per square metre. Provide entire panel fabrication which is non-combustible, moisture resistant, dimensionally stable, with no protruding parts. No exposed vertical trim or kick plates shall be allowed.

(b) Size of each unit panel shall be in the range of 600mm to 1220mm in width unless otherwise specified in Drawings.

(c) When panel height exceeds 7m, the manufacturer shall submit structure design calculations to show panel structure integrity.

Panel Finishes

(a) Panel surfaces shall be furnished with a rust inhibitive prime point. The sound insulation qualities specified shall be maintained. Final architectural finish on panels shall be not less than 12mm on each side of the panel. They shall either be particle board or gypsum board assembled to appropriate acoustical backing.

Expandable Panel

(a) Provide as final closure for each partition shown an expandable panel of same construction as panels. Expandable panel shall have mechanically operated top and bottom seals.

Seals

(a) Vertical seals between panels shall consist of tongue and groove configuration with deep nesting, inter-locking astragals incorporating continuous, concave/convex magnetic strip and vinyl acoustical seal.

(b) Horizontal seals shall be spring loaded crank seals simultaneously activated by means of manual crank handle and develop 100 kg pressure per panel at track and floor when fully extended. Seals shall be self-compensating and be of double shell construction for acoustical isolation. Sweep type multi-finger top seals and automatic type top and bottom seals shall not be permitted.

(c) A slip clutch shall be incorporated as part of the crank mechanism that activated the top and bottom seals of each panel. This clutch shall prevent excessive or damaging compression forces from being applied to the sealing components regardless of force applied at crank handle.

(d) Seal systems which require the movable partition panel to be jacked up, transferring the panel load to the floor, will not be accepted.

(e) Seals shall be self-compensating and be of double shell construction for acoustical isolation. Sweep type multi-finger top seals and automatic type top and bottom seals will not be permitted.

(f) All seal material shall be full width, have a hardness (durometer rating) compatible with floor finished, be resistant to fatigue and cleaning compounds and shall not mar floor or ceiling finished.

(g) The floor seal shall accommodate panel clearance with respect to the floor and any changed in clearance duo to structure deflection. All top and floor seals shall be out of contact with the respective surface during movements of the panels.

(h) The movable acoustic partition system shall be designed to accommodate the deflection due to structure dead loads and likely live loads at any point of the spans whilst maintaining all specified operational and acoustical requirements. The manufacturer shall design the seal mechanism to accommodate this range of movement whilst maintaining the specified contact pressure.

(i) Horizontal sound seals between panels and top supporting track/floor shall be retractable and provide the normal operating clearance, which should be follow with the manufacturer’s guideline or test report.

Suspension System

(a) Track shall consist of clear anodized architectural-grade aluminium alloy 6063-T6 or minimum 5mm galvanized steel. Track, which incorporates alignment pins for positive alignment, shall be unitized for optimum sound control and have integral support for adjoining ceiling, soffit or plenum sound barrier.

(b) Track intersections must be designed and constructed to enable smooth operation. They shall be made of the same grade of architectural-grade extruded aluminium as the regular straight track without variation in texture and colour.

(c) The track and other suspension members shall be designed to accommodate panel loads including the specified applied finished.

(d) The bolts and trolleys shall be incorporated with safety mechanism to prevent any danger of self-unwinding. Each panel shall have the facility for height adjustment without having to open up the ceiling panels after the ceiling is closed.

(e) Tracks shall be secured to the building structure and/ or suspension structure by adjustable bolts. All necessary transfer and storage tracks shall be included.

(f) Track carriers shall be dual wheel trolleys that made of precision ground steel ball bearing wheels encased in molded polymer tires to protect aluminium running track surface. Provide heavy duty multi-roller carrier equipped with 4 steel ball bearing wheels. Carriers using sliding polymer disk (pucks), counter rotating wheels or ball bearing supported trolleys are not acceptable. Provide 2 carriers for each single panel. No mechanical or electrical switching devices will be permitted.

Pass doors

(a) Pass doors shall be installed in the movable partition system complete with locks and other ironmongery where shown in the Drawings.

(b) Pass doors shall be sealed airtight with respect to jambs and floors when closed. Seals shall be fatigue free and full compression of all seals shall be maintained when pass doors are closed, despite repeated operations of the doors.

(c) Pass door panel construction shall preferably be similar to partition panel construction and shall not degrade panel performance. Single or double inset pass doors of the same panel thickness without protruding door hardwares shall be available.

Acoustic Performance

(a) Laboratory Testing:

The supplier/manufacturer must demonstrate in accordance with **ASTM E90-90** that STC 55 or above sound separation can be achieved for each single movable partition system. The movable partition system tested by an accredited independent laboratory must have been performed with at least three panels with no surface finishes to include two vertical joints and horizontal joints (top and bottom seals) similar to the real installed condition. The test proposal shall be submitted for approval.

The movable acoustic partition system selected shall meet both the above minimum specified site and laboratory sound insulation values.

(b) Field Testing:

After installation of the movable partition is completed and to the satisfaction of the partition manufacturer or his designated representative, the partitions shall be set up by the manufacturer or his representative and provide initial field test by an accredited independent laboratory. The manufacturer or his representative shall be on hand to observe the field testing and to make partition adjustments as required.

Noise reduction shall be as described by NIC 42 (for single movable partition system) and NIC 50 (for double movable partition system).

Noise reduction measurements will be made in general conformance with **ASTM E336** as it applies to measurement of isolation between rooms. The NIC rating will be calculated in accordance with **ASTM E413**.

Acoustical Separation Requirement and Specification	
Space Separation	Noise Isolation Class (NIC)
Single movable partition system	NIC 42
Double movable partition system	NIC 50

Movable and collapsible partitions between patient beds **22.96*** Proprietary movable and collapsible partition for specified location (e.g. for contact isolation between two adjacent patient beds) shall be ceiling mounted or mounted on trolley for ease of movement and conveniently mounting and demounting on wall via secured clip-in mechanism with spacers, adjustable if required to suit the wall fixtures, or with support clamps attached to medical rails.

PROTECTIVE SYSTEM FOR WALL AND DOOR

Protective handrail **22.97*** Shall be PVC-free vinyl protective handrail system with surface height of approximately 140mm and a pre-formed 38mm dia. gripping surface. The system shall incorporate 2mm thick PVC-free vinyl snap-on covers with impact modifiers, but without plasticizers. The backing shall be 2mm thick continuous aluminium retainer fabricated from 6063-T5 aluminium in mill finish fixed on adequate mounting brackets. Injection molded thermoplastics accessories including inside/outside corners, returns and brackets shall be in pebblette texture surface and contrasting colour from wall finish.

Protective crash rail **22.98*** Shall be PVC-free vinyl protective crash rail system with surface height of approximately 100mm. The system shall incorporate 2mm thick vinyl snap-on covers with impact modifiers, but without plasticizers.

The backing shall be 2mm thick continuous aluminium retainer fabricated from 6063-T5 aluminium in mill finish, which shall be mounted with a 2mm thick vinyl continuous impact bumper to enhance impact resistance performance. Injection molded thermoplastics accessories including end caps, inside/outside corners and brackets shall be in pebblette texture surface and contrasting colour from wall finish.

Corner guard **22.99*** Shall be PVC-free vinyl protective corner guard system with wing width of 51 x 51mm and 1220mm in height. The system shall incorporate 2mm thick vinyl snap-on covers that shall be extruded from chemical and stain resistant polyvinyl chloride without plasticizers and the continuous 1.8mm thick vinyl retainers shall incorporate a co-extruded flexible vinyl apex fabricated from polyvinyl chloride with the addition of impact modifiers for high impact resistance performance. The top and bottom caps shall be made of injection molded thermoplastics.

Protective wall guard **22.100*** Shall be PVC-free vinyl protective sheet of 1.5mm thick in velvet texture with accessories including top caps, vertical divider bars and inside corners made of injection molded thermoplastics and in matching colour with the vinyl sheet. Adhesive to be used shall be accepted by the protective wall guard manufacturer to ensure full product compatibility.

Protective door frame guard and door protective plate **22.101*** Protective door frame guard shall be manufactured from 1.5mm thick PVC-free vinyl and custom made to perfect match with the steel door frame. Protective door plates shall be 1mm thick PVC-free vinyl with impact modifiers, but without plasticizers.

Rubber bumper rail **22.102*** Rubber bumper rail shall be extruded from heavy duty ethylene propylene diene monomer (EPDM) of appropriate 200mm high and 32mm thick and shall be UV resistant and ageing resistant. Integrated high visibility strips shall be provided for parking areas.

FURNITURE

Fixed furniture **22.103***

(a) All fixed furniture, including cupboards, lockers, pigeon holes, reception counters, servery counter and hatches, shelves, racks, cabinet and work benches and other fixed furniture for mock purposes shall be designed to suit the layout requirements of the individual user and built to a heavy duty finishing standard as appropriate to its use.

(b) Fixed built-in furniture shall be constructed with marine plywood and hardwood frame. All timber works shall be treated and coated with coloured wood preservative and all surfaces shall be finished with plastic laminate or other approved proprietary coating system.

Paintings to timber works shall comply with the **General Specification for Building**.

(c) Unless otherwise specified, cupboard doors, shelves and drawer fronts and insides shall all be made of 19mm thick moisture resistant grade plywood and faced on both sides with 1mm thick (minimum) approved high pressure laminated plastic sheeting.

Exposed edges shall be beaded with rounded solid oak/maple. Work top shall be solid surfacing material with raised edges and 100mm high coved backsplash supported on 25mm thick plywood carcase. Sealant to be provided to top of board interfaced with wall and selection of colour shall match the wall tile finish and overall design.

Where specified, stainless steel finish to worktops are to be hairline/satin finished and of grade 316 stainless steel. Extruded anodized aluminium door/ drawer pull handles shall be provided.

(d) Unless otherwise specified, work benches shall be 900mm high, 600mm deep and supported by 50mm x 50mm powder coated mild steel frame and legs; wall mounted cupboards shall be 350mm deep and 900mm high or up to false ceiling, if provided, with adjustable hinged doors and adjustable shelves.

(e) Each drawer shall be provided with proprietary drawer slides on both sides, pull handles and drawer lock. Drawer slides shall be ball-bearing full extension runners, heavy duty of adequate loading capacity, integrated with soft-closing function that shall be closed quietly and gently. Drawing runners shall be tested to **BS EN 15338** and complied with column 2 test parameters in Annex C of **BS EN 15338**.

(f) Each cupboard door shall have at least one pair of proprietary hinges, magnetic catches, pull handles and cabinet lock. Cupboard door hinges shall be concealed hinge with min. 110 degrees opening angle, snap-on assembly and integrated soft-closing function that shall be closed quietly and gently.

Cupboard hinges shall be tested to **BS EN 15570** and complied with column 3 test parameters in Annex B of **BS EN 15570**. Top hung cupboard door hinges shall be flap fitting type with dampened soft closing action for safe closing quietly and gently. For hanging cabinet door panels with height greater than 600mm, additional middle hinge shall be provided.

(g) Cabinet for enclosing safes shall be built with marine plywood and hardwood frame constructed on a concrete plinth. The safe, supplied by the end user, shall be fixed to the concrete plinth with GMS angles.

Shower seat **22.104*** Shower seat shall be made of ABS with stainless steel folding bracket and assemblies to withstand a minimum seat load of 150kg.

Shower gel tray **22.105*** Large size shower gel tray shall be A proprietary product in the form of a comer tray made of grade 316 stainless steel.

Stainless steel worktops, upper and lower cabinets **22.106***

(a) Stainless steel worktops shall be monocoque and sound deadened in locations and sizes as indicated on detailed drawings. Profiles shall be fully encapsulated with reinforcing to provide a stable high, impact resistant worktops surface.

(b) Stainless steel plates, sheets and strips shall comply with **BS 1449-2**. Stainless steel tubes shall comply with **BS 6323-1** and **BS 6323-8**. Unless specified otherwise, stainless steel to be used shall be type 316 with min. thickness of 2mm and shall have a No. 3 – dull buffed finish.

(c) All stainless steel worktops shall be factory fabricated and assembled. Only single length members free from distortion and defects shall be used. Cut edges, drilled holes and flat sheets shall be clean, neat, free from burrs and indentations. Sharp edges shall be removed without excess radiussing.

(d) Joints shall be fitted accurately to fine hairline. Folds in sheet shall be made with minimum distortion; buff off marks of any kind occurring from presses or other sources. During assembly and erection, strain, twist, bend or open such items to bring them to their true positions shall not be allowed. Finish of sheet metals shall match with tubes. Bends in tubular steel shall be made with minimum distortion; crushed bends or collapsed bends will not be accepted.

(e) Benches and the like shall be constructed in the largest practicable sections that can be handled and installed in the positions shown on detailed drawings.

Where field joints are necessary between other stainless steel tops or worktops with plastic laminate surface locate them only at approved location and make them in such manner that the completed work will be liquid tight and free of dirt crevices and present the best appearance of unity, continuity and finish. Joint between two stainless steel worktops or between stainless steel worktop and stainless steel sink shall be welded to achieve a seamless finish.

(f) 308 electrodes shall be used for 304 grade materials; while 316 electrodes shall be used for 316 grade material. Welding rods shall match strength and colour of the welded materials. Proprietary stainless steel pickling paste shall be used to clean and passivate all welds in stainless steel sheet and tube.

(g) Argon arc method shall be used for welding as specified in relevant British standards. Butt edges and faces to be welded shall be evenly match. Where joints made by these methods are visible, they shall be finished by grinding, buffing, or the like methods appropriate to the class of work. Welds at internal angles shall be neatly finished. Welds at external angles shall be finished smooth and slightly rounded to match edges of tube. Welds to joint shall be grinded smooth on aligned faces to give an invisible joint.

Do not reduce thickness of the base metal section; maintain edge radius of tubing on exposed ground edges. The completed unit shall be free from distortions and defects, with all components properly aligned and closely fitted. All open ends of tubes including 45 degree ends to bench frames shall be closed with metal plates fully welded and grounded off to match edge radius of tubing unless otherwise noted on drawings. All welds shall be passivated and cleaned with stainless steel pickling paste in accordance with manufacturer’s recommendations. All welds shall be stain-free on completion. On-site welding shall not be allowed.

(h) Drilling or punching shall be coordinated with other trades to form openings for services and fittings and to provide fixings as necessary. Burring shall be removed from resultant holes. Dimpling shall be provided at holes to take screw heads.

(i) Fixings, fastenings, brackets and the like shall be capable of transmitting the loads and stresses imposed and ensure the rigidity of the assembly. Fastenings shall be in stainless steel; conceal fastenings shall be used where possible. Where fixings are made through plasterboard wall or cement board sheeting, galvanised tube ferrules as spacers shall be provided to avoid crushing of wall sheeting. Appropriate screw/ bolt fixings or anchors shall be provided.

(j) Stainless steel bench framing system shall be fitted with adjustable feet. Adequate bracing and cross bracing shall be provided to support bench tops to avoid sagging.

Metal racks, shelving and cabinets **22.107***

(a) Proprietary metal shelving system shall include racks, shelving and storage cabinets of appropriate loading capacity in areas as specified. The proprietary metal shelving system shall be fully adjustable, complied with the requirements of **BS 5454** and easy to install with comprehensive range of shelves and easy-fit accessories.

(b) The proprietary metal shelving system shall be supplied with a range of accessories including doors, back panels, end and dividing panels, back bracing, dividers and joint ribs etc. Exact types of accessories for each metal shelving unit shall be designed to suit users'.

(c) Range of available size of the proprietary metal shelving system shall be 2000mm to 3000mm in height and 300mm to 600mm in depth. Exact dimension of shelving units in each area shall be designed to suit room layout, false ceiling height and users' requirements. For general purpose shelving unit, a standard shelf shall be able to support loading of 200 kg in a size of 600 x 1000 mm or 150 kg in a size of 400 x 1000 mm.

(d) All components of the proprietary metal shelving system shall be finished with epoxy powder coating in colour selected from the factory standard colour range.

Counters and Nurse Stations **22.108***

(a) Generally, public accessible counters including but not limited to the use of reception, information, enquiry, etc. shall be made of a combination of materials of at least 3 columns and patterns, including marble/granite/solid surfacing material (for the counter top), as well as plastic laminate on top of 20mm plywood backing (for the worktop base and drawers) with mirror/satin finish stainless steel or other special materials (as highlight features and for the skirting).

(b) Walls of counter areas shall be finished in a combination of materials to suit the special interior design requirements. Featured walls in powder coated aluminium panels, vinyl wall paper with special patterns or art glass or similar materials shall be provided to suit the theme of the space. Accent lighting and indicator integrated with the Queue Management System shall be provided.

(c) For specified location (e.g. nurse stations), counter shall be custom-designed to suit the workflow and spatial requirements of the medical staff, fully integrate the workstations, monitoring consoles, wash hand basin, pneumatic tube station, master control panels for building services, security and access control system, storage cabinets for medical records, consumables, etc, with the parking alcoves for trolleys and other equipment in a coherent and neat manner.

Seamless solid surfacing materials shall be used for the work top and accent features of the counter.

(d) Except for open counters as otherwise specified, an anti-vandal and burglar-resistant polycarbonate sheet or super clear laminated glass of appropriate thickness and impact strength shall be provided to each one of these counter as safety and security screening, Intercom shall be provided at both sides of each counter to enhance communication between staff and public/patient.

Assistive listening system shall be provided and integrated into the interior design to at least one counter for each group of counter. Telephone facilities shall be provided linking with outside lines. Integrated lighting shall be provided to the counter, Amble space to be provided for computers and monitors.

(e) Super clear safety glass panels shall be provided for all shroff counters. Seamless solid surfacing materials shall be used for the counter top of enquiry counter and shroff counter. Special casing & millwork with access doors shall be designed for housing the electronic displays and associated BS installation (to be installed by Others).

(f) Unless otherwise specified, all counter tops shall be made of 18mm thick marine plywood with min. 9mm thick seamless solid surfacing material finish with approved rounded edges. Where specified, the same solid surfacing materials shall also be applied to integral sink of the counter tops, front apron and back splash.

Wall mounted lead arpon racks **22.109***

(a) Type I lead arpon racks shall be single rail of approximately 945mm long, projecting 130 mm from the wall and capable of supporting one lead apron. It shall be made of chrome plated mild steel tube complete with wall plugs and fixing screws.

(b) Type 11 lead arpon racks shall extend 620mm from the wall when perpendicular to the back plate and shall fold right and left about the centre point of the backplate. It shall be made of polished stainless steel complete with back plate, six support arms and four plugs and fixing screws. It shall be capable of supporting the weight of six lead aprons over supporting arms with five-knuckle hinges. The bottom corrugated support shall be permanently attached. The top holder may be removed for easy fitting of the supports.

(c) All fixing screws/plugs for mounting the lead arpon racks that penetrate lead radiation shielding shall be protected with additional lead plug to prevent compromising and maintain integrity of the radiation protection.

Bedpan racks **22.110***

(a) Wall mounted stainless steel bedpan drying racks shall be min. 660mm long suitable for storage of six standard bedpans.

(b) The entire assembly together with fixings appropriate to the supporting wall shall be capable of supporting the weight of the assembly plus a fully loaded compliment of six of the type of bed pan employed by the hospital.

(c) Each unit shall consist of two grade 304 stainless steel wall mounting bars 25x812 mm long by 6 mm thick 385mm vertically apart overall. Racks shall be formed from 10mm grade 304 #4 stainless steel rod welded to the wall bars by heli-arc method and shall be polished to remove any burrs or uneven surfaces.

Each rod shall extend from the mounting plate a distance of 127 mm before bending at 45 degrees to extend a total horizontal distance of 356 mm and thence a reverse bend to return to the lower mounting plate. Overall height of the rod assembly shall be 210mm (+/- 2%). There shall be a total of seven rod assemblies spaced 127 mm on centers.

Laboratory furniture system **22.111***

(a) Laboratory work benches supported by heavy duty steel frames (H-frame or C-frame) shall meet the safety and health requirements in accordance with **EN 13150**. The supporting frame shall be finished in epoxy-polyester powder coating with a minimum film thickness of 1.5 mils. All benches shall be provided with adjustable legs for levelling. The minimum loading capacity of each bench shall be 5001bs per running meter.

(b) Unless otherwise specified, all worktops for laboratory benches shall be laboratory grade chemical resistant epoxy resin with nominal thickness of 25mm (minimum) with marine edges and back splash upstands. Front edge

shall be bevelled with nominal 3mm width.

It shall be of self-supporting duroplastic epoxy resin mixed with quartz powder. The boards shall be produced by finished casting. The surface shall be even, chemical resistant, heat and flame resistant, scratch resistant, dull finish and non-reflecting. The joint shall be grounded and joined with watertight, impregnated, compression strip with silicon suitable for laboratory applications.

(c) Sink units of laboratory bench shall be integral with the work surface, provided with unslotted strainer waste, fitted bucket grating with plastic bottle trap, etc. Any bonding or jointing shall be carried out under factory conditions so as to provide a homogeneous assembly. Sinks and drain tops shall be fabricated of minimum 20mm thick cast seamless epoxy resin or chemical resistant ceramic as appropriate. All laboratory sinks shall be completed with chemical resistant bottle trap with dilution tank before the branch waste pipes.

(d) Laboratory cabinets including but not limited to under bench units, suspended under bench mobile units, over-bench units, pull-out units, wall mounted units and reagent shelves shall meet the safety and health requirements in accordance with **EN 14727**.

Under bench mobile cabinet units shall be constructed and attached to the supporting frame of the bench with a horizontal sliding system which allows the cabinets to slide through the entire length of the benches. Cabinets shall also be removable and interchangeable from bench to bench. Laboratory cabinets shall complete with adjustable shelves, soft-closing hinged doors, fully extendable soft-closing drawers, handles and other accessories from the product line as required by the Supervising Officer. Individual locks shall be provided for each cabinet door and drawer.

(e) Service spine and reagent shelves shall be fabricated in galvanized steel with epoxy paint coating of not less than].5mil thick. Reagent shelves shall be adjustable along their vertical end supports, and provided with marine edges to contain any spillage of liquid on the shelves.

(f) Service channels shall be fabricated in sheet steel, with climb duct for connections from below the work top module. Each service channel shall be equipped with a segregated channel section for the provision of power, compressed air, gas, communications/data and plumbing.

Physiotherapy installations

22.112* **Overhead suspension frame**

(a) Material: grade 304 stainless steel

(b) Design loading: to sustain at least 250kg force

(c) Notional dimensions: 2000x1 350mm

(d) Installation height: 2300mm from finished floor level

(e) Component and construction details: main frame shall be made of 50x50x3mm angle. Movable frame shall be made of 25x25x3mm angle. Diameter of rod shall be not less than 4mm. Dimensions of rectangular grid shall be approximately 50x50mm.

Wall mounted frame

(a) Material: grade 304 stainless steel

(b) Design loading: to sustain at least 250kg force

(c) Notional dimensions: 1000x1500mm high

(d) Installation height: lower end shall be 500mm from finished floor level. The whole frame shall be mounted with a separation of 50mm from wall.

(e) Component and construction details: main frame shall be made of 50x50x3mm angle. Movable frame shall be made of 25x25x3mm angle. Diameter of rod shall be not less than 4mm. Dimensions of rectangular grid shall be approximately 50x50mm.

Wall bars

(a) Material: solid maple

(b) Finish: synthetic varnish

(c) Design loading: to sustain at least 250kg force

(d) Notional dimensions: 1000x2150mm

(e) Installation height: The lowest horizontal bar shall be 200mm from finished floor level.

(f) Component and construction details: There shall be 13 nos. horizontal bars of 1.5 inches diameter and 6 inches apart from each other. The horizontal bars shall be supported by two vertical supporting bars (each of approximately 110mm wide and 37mm thick) securely fixed on wall. A hanger unit shall be provided for each set of wall bars.

OB pulleys

(a) Components:

(i) All-ball-bearing metal pulley wheels;

(ii) Free floating, chrome plated solid steel slide bars;

(iii) Non-plastic, spring loaded adjustment pin; and

(iv) Computer, precision cut weight increments.

(b) Performance:

(i) The system shall be a double weight and pulley system consisting of two single sets mounted on the wall 600mm apart, one pair of pulley systems shall consist of two single sets.

(ii) The training height shall be adjusted easily and safely. The equipment shall be smooth to operate and quiet to use.

(iii) There shall be at least 28 nos. of 0.5kg weight stacks for each single set.

(iv) Total height of the pulley system shall be at least 2.3m from finish floor.

(v) Exact location of sets to be directed by end user on-site during installation. It shall be installed together with wall bar.

(vi) Locking pin shall be provided to regulate loading.

(vii) Range of training height shall be 100-2200mm above floor finished level.

(viii) The position of the pulleys shall be firmly fixed with the use of a locking pin. No disengagement caused by the vibration generated during the operation of the pulley will be allowed.

(ix) The accessories set to be provided shall include cuffs/handles.

Patient hoisting system

22.113*

(a) Proprietary hoisting system shall be overhead hoist system for patient lifting and transfer via moveable track mounted on fixed tracks and rail systems suspended underneath the false ceiling. The manufacturer's catalogue specification, technical data, users manual, test reports, guarantee as appropriate of the proposed system shall be submitted to the Supervisor Officer for approval prior to ordering.

(b) The patient hoisting system shall be easy to operate for routine transfer of non-ambulatory individuals with all units powered by a ceiling lift that make use of a cassette requiring no extra electric installations.

(c) Installation of the system shall provide a minimum clearance of 2.3m between the bottom of the hoist and the floor to allow for smooth operation. Suspended ceiling level and the door and door frame construction details shall be coordinated to suit the requirement of the system and minimize the pressure drop in pressurized room.

(d) The hoisting system shall provide full coverage to all patient beds in the ward cubicles areas as specified by means of movable tracks for patient transfer from each bed to the adjoining en-suite toilet/shower and the respective assisted/disabled toilet/shower room within the same unit; and in the case of Bums Unit, from each bed to the hydraulic bathroom and minor OT.

(e) The hoisting system with movable tracks shall also be provided for full coverage of all individual patient beds or within the rooms in areas specified.

(f) The hosting track system shall be a versatile track system which offer the best coverage options and allow modular track approach that enable flexible solutions by track layouts that could optimize the functional needs of the working space, such as transverse room covering system that offers good coverage for a ward; central turntable that increase coverage; and curved track together with an exchange that shall be incorporated to provide an optimum layout solution.

(g) The track rail shall be at the same level to allow the hoist to move easily along the rail by hand and to keep the hoist stable at any location. The bracket of the system shall be supplied from the same manufacturer, be able to achieve the maximum lifting capacity, and can offer time effective installation.

(h) Patient hoisting system shall complete with the following features:

(i) complies with **EN ISO 10535** and **CE** marked;

(ii) complies with **EN 60601-1**;

(iii) complies with **CS A No. 60 1.1** and **UL No. 260 1-1**;

(iv) respects electromagnetic interference standards;

(v) lifting capacity of minimum 200kg;

(vi) ABS fire retardant casing and hand control;

(vii) hand control shall have santoprene tactile buttons and sealing effectiveness of IP44;

(viii) Infrared remote control;

(ix) strap length to suit operation and ceiling height;

(x) power operated lifting operation with soft raising and lowering to reduce patient swing and with safety device to stop lifting if the lifting strap is either twisted or misaligned;

(xi) equipped with electronic microprocessor for soft start and soft stop motor control to ensure the lift can always be stopped/started smoothly and safely in the exact required position;

(xii) emergency brake system (in case of mechanical failure);

(xiii) manual emergency lowering device on the motor cab;

(xiv) electric-operated up and down emergency buttons;

(xv) hoist integrated with scale;

(xvi) overload circuit protection current limiter;

(xvii) low battery disconnect system to prevent use of lift if the battery is low;

(xviii) adjustable horizontal displacement speeds; 100, 150, 200, 200mm/sec. and optional manually horizontal displacement;

(xix) LED indicators for power-on, charging, maintenance, low battery (also with audible sound), etc. ;

(xx) charger unit shall have pow'er indicator on charging module, park & charge or clip on charger anywhere on the track, Class 2 insulated; and

(xxi) automatic charge function.

(i) Complete range of loop and clip slings for use on the applicable 4-point or 2-point spreader bar shall be provided. 4-points hook-ups, locate between patient knees and outside shoulders, shall also be provided.

Intravenous track system **22.114*** Proprietary intravenous (I.V.) track shall be made of extruded anodized aluminium with reinforced comers, available in single or double straight runs with end stops and/or bent to required radius for oval or U-shape installation. Inside raceways shall be smooth to allow for uninterrupted movement of the carrier. The carrier shall consist of nylon rollers and body carrier, nylon carrier lock and stainless steel carrier loop.

End Stop and Pull Out Assembly shall be fabricated to provide easy insertion of the carrier into the inner raceway of the track. Splicer shall be provided for joining of track pieces or U-shaped tracks to form a complete oval. Accessories shall be available in the form of carriers and telescopic. In general, minimum one tree per track shall be provided or as otherwise instructed by the Supervising Officer.

Medical rail system **22.115*** (a) Medical rail system for supporting medical equipment shall comply with **BS EN ISO 19054** and shall be supplied with accessories such as mounting brackets, end caps, insert strips and rail connectors in ward cubicles and clinical areas as appropriate.

(b) Heavy duty medical rail shall be made of natural anodised aluminium extrusions, able to support 100kg between fixing points and span windows or non-supporting areas (maximum 1200mm length between fixing points).

(c) Mounting brackets shall have at least 4 mounting sets for every' 3-metre length. Mounting set shall have an adjustment feature for the correct positioning of monitor shelves. Mounting accessories shall be available for mounting of individual equipment.

Baby changing facilities **22.116*** Proprietary nappy changing stations shall be surface mounted or recess mounted on countertop with raised edge and wipeable soft mat in babycare rooms. Baby changing station shall be made of durable high-impact polyethylene body and smooth concave changing area with a safety strap and universal instruction graphics.

Proprietary wall-mounted baby changing station shall be in horizontal format with foldable baby bed made of durable high-impact injection moulded polyethylene with anti-bacterial, anti-fungal and smooth concave bed surface. The changing station shall conform to **ASTM F2285-04** Standard Safety Performance Specification for Diaper Changing Tables for Commercial Use and be secured to the metal mounting chassis with a fully concealed steel-on-steel hinge and equipped with pneumatic cylinder for controlled opening and closing of bed. Concave bed shall be equipped with nylon safety straps and hooks for comfort and safety. The unit shall have a built-in liner dispenser for use with 3-ply chemical free biodegradable bed liners, instructional graphics, multi -languages safety instructions and Braille labels.

Proprietary baby/child restraint seat shall be wall mounted with foldable seat made of durable high-impact polyethylene with anti-bacterial, anti-fungal and textured surface. The seat shall be secured to back plate with a concealed, full length stainless steel hinge embedded in the plastic and equipped with nylon safety straps that shall extend over child's shoulders and between legs for security.

Linen chute system **22.117***

(a) The linen chute system shall consist mainly of chute trunk, entry side hung door sets, ventilation pipe set, discharge section and inspection panel. The electrical and mechanical components of the system shall be of proven quality complying with the requirements as specified.

(b) The internal diameter of chute trunk straight sections shall be min. 750mm. Entry units made from 1.5 mm thick grade 316 stainless steel sheet rolled shall be weld joined. The chute pipes shall be linked up by angle ring joints and telescopic joints. Each floor shall have a telescopic joint to allow for slight variation in floor-to-floor height and thermal expansion/contraction. The chute trunk shall be supported at each floor level with a galvanized mild steel support frame/clamp band bolted to floor slab/wall.

(c) Side hopper doors shall be made of grade 316 stainless steel, electrically operated, double skinned, side hinged and self-closing by means of a hydraulic door closer. It shall have a fire rating of 2 hour to **BS 476-22**. The access shall have a min. 600x600mm clear opening and shall allow fully loaded linen bags to pass through easily. The opening of hopper doors at each floor shall be about 500mm above floor.

(d) Grade 316 stainless steel cover plate with angle ring shall be bolt fixed to the top of the chute trunk. Extending upwards from the plate to the roof shall be a 255mm internal diameter 1mm thick stainless steel ventilation pipe. A continuously operating exhaust fan and fan mount shall be fitted at the bottom of the ventilation pipe. Adequately sized inspection/maintenance panel shall be provided for access to and removal of the exhaust fan. The exhaust fan shall be of adequate duty for ventilation requirement of the chute. The fan and motor shall comply with requirements specified.

(e) The whole discharge section shall be made from stainless steel plate. The linen chute shall discharge bagged linen via a 1.5mm thick square section bottom end (45° to horizontal) fitted with a 3mm thick stainless steel automatic fire cut-off door at the discharge end. The operation of this door shall be by vertical counter balance actuated by a 1 65° fusible link. In case of a fire, the fusible link shall break and the door shall drop shut.

(f) Grade 316 stainless steel double skinned, side hinged and hand operated inspection panel of 600x600mm clear opening shall be provided for removal of exhaust fan complete with wall frame located above the entry side hung door set on the uppermost floor level. An emergency stop (manual override

with interlocking) shall be provided near the inspection panel to safely shut down the chute system.

(g) Each entry door shall be provided with an electric interlock. The electric interlock shall be mounted in the upper portion of the doorframe of the entry door. Operation shall be by push button, with two indicator lamps, green indicating ready for operation and red indicating system in use. When the red light is on, indicating the system is in use, the door shall be locked. The interlocking system shall also cover the lowest discharge point or the access door to the room where the discharge point is located.

An alarm signal shall be given to notify the operator to close the door properly if the door is not closed within a certain period of time. The master control box for the interlocking system shall be mounted in the soiled linen room where the linen chute discharge point is located. The master control box shall consist of an indicator board which shows the status of all side hung doors above. A main key switch shall be provided to override all the switches of the side hung doors.

(h) An alarm shall be given when any of the entry doors is not closed within a certain period of time. The entry doors can be opened manually by keys when the system is down due to electric supply failure or other faults. The interlocking system shall operate on a 24V electric supply, and shall have a manufacturer's factory fitted timer. The timer shall be able to be set by the user to allow single use of the chute at any given time.

(i) An electrically powered automatic chute cleaning system shall be provided above the top most entry section/inspection door. The cleaning system shall consist of a cylindrical housing, with two bands of stiff nylon brushes firmly attached, a geared electric motor, cable, weight, flushing head spray and electric logic control shall be installed to ensure efficient cleaning of the internal surfaces of the chute.

(j) A disinfectant and sanitizing unit shall be provided above the top most entry section. The unit shall be automatic in operation, and capable of injecting "Selsan EQ5" or equivalent deodorizer and disinfectant into the water supply of the automatic cleaning device for flushing of the internal surfaces of the chute.

(k) The system shall have an ozone generator for destroying odour molecules. It shall be mounted on the wall at the linen chute room. The odour neutralizer circulates the ozone, permitting it to search out, destroy odour molecules and to convert them into water vapour and odourless, harmless gases.

Blinds **22.118*** (a) Blinds shall be shall be anti-ligature design. The materials of the blinds shall be anti-bacterial, rot-free, waterproof and corrosion-resistant. The density shall be sufficiently high for easy cleaning for infection control and protection purpose.

(b) Manually operated sunscreen roller blinds shall be strong and durable, offering protection from UV and solar heat and shall be provided for specified area. Sunscreen fabric of roller blinds shall comply with the Type A performance requirements of **BS 5867-2**.

(c) Electrically operated sunscreen motorized blinds shall be provided for all glass walls and skylights with remote control system and side tracks neatly integrated with the windows & reveals.

(d) Blackout roller blinds shall be motorized roller blinds with remote control system shall be 100% blackout roller blinds with side tracks neatly integrated with the windows & reveals.

25mm Venetian Blinds with Break-Thru Safety Tassel (Child Safety)

(a) The headrail shall be of channel section measuring 25mm wide and 25mm deep and rolled from pre-coated 0.5mm zincalume finished in oven-baked alkyd enamel over an epoxy primer.

(b) The bottomrail shall be roll-formed from pre-coated 0.5mm zincalume finished in oven-baked alkyd enamel over and epoxy primer.

(c) The lift cord guide roller shall be of nickel plated brass and the tilt rod shall be of hot dipped galvanized "D" section steel wire of 2mm radius and measuring 3mm across the flat side.

(d) Slat shall be made from high tensile aluminium coilstock of 6011 alloy, and be complied with the requirement of strength and flexibility in accordance with **BS 3415**, and be 25mm wide with a 5 mm overlap and a minimum of 0.2 mm thick after coating.

(i) The crowned coilstock shall withstand bending through 180 degrees, over a mandrel of radius 12.5mm, without incurring permanent deformation.

(ii) The paint formulation will be a thermosetting polyester coating over a chromate conversion coating, and shall at all times conform to rigid quality standards.

(iii) The paint thickness shall be 12+/-2 microns, and shall conform to colour standards defined in **ASTM D2244**.

The tilt stop shall be fitted to the tiltrod to limit tiltrod rotation at full closure positions.

The string tape shall be of 2-ply spaced ladder construction each rung comprising two strands spaced 2.5mm apart and woven from approved polyester fibre.

The polyester cord shall be 1.4mm diameter and of approved manufacturer.

The intermediate installation brackets shall be of pressed steel construction finished in clear passivated zinc plate and suitable for either face or top mounting.

89mm Vertical Shades (Fabric)

The head channel shall be 33mm wide and 30mm deep, extruded from 6063-T5 aluminium alloy finished in clear or bronze anodizing to a thickness of 10 microns, or powder coated to a film thickness of 25 microns.

Fabric vanes (89mm width) shall be 100% polyester vanes are provided with bottom pockets housing slat weights which are coupled together by means of endless plastic bead chains pivotally attached to each side of each weight.

The slat overlaps will vary according to slat width and shade width but will never be less than 15 mm. Centre overlaps are always 20 mm minimum.

The spline shaft shall be a tri-lobular aluminium extrusion of 6063-T5 alloy.

The traversing cord shall be 1.7mm diameter and constructed with a braided polyester jacket over a polyester core.

The bottom linkage shall couple adjacent vanes at the base to minimize differential movement of vanes.

The bottom weight shall be of moulded PVC compound incorporating an inert filler of high specific gravity. Integrally moulded posts supported both top and bottom shall be provided to enable pivotal attachment of a bottom linkage chain at each side of the weight. All parts of the weight shall be of a smooth finish to facilitate assembly into the bottom pockets of a fabric vane. Lateral movement of the weight during transport will be avoided by a shoulder moulded into the top of the weight behind the pivot post.

Operation: Horizontal blinds shall be capable of operating with tilt and traverse controls either singly or together on either left or right ends. The blind shall function in either one-way or two-way draw situations with end or center stacking. Split-draw operation shall also be possible. Motorized system is also available.

Tack Board/ Pin Board / White Board **22.119*** Tack board, pin board and white board shall be proprietary products and integrated with demountable partitions, and of minimum size of 900x1800mm unless otherwise specified.

Magnetic Chalkboard **22.120*** **Magnetic Chalkboard**

The chalkboard shall be constructed with facing sheet of 2 coated fired vitreous porcelain enamel, 0.4mm thick, on 15mm think plywood backing. Perimeter trim to be extruded aluminum channel 25mm x 30mm overall dimension to be fitted around panel with round rubber corner. Chalk trough to be extruded anodized aluminum tube non folding type with ends to be closed by round rubber end closure installed with concealed bracket fastener. Protective film of polyethylene strippable film 40 mm microns to be provided.

Custom-made full height magnetic chalkboard in Special Rooms shall be surrounded by concealed square edge system. Edge and corner is to provide perfect sharp, straight alignment. No screws head to be exposed on front side. GMS “L” shape bracket to be provided for conceal wall fastening.

25 x 80mm Heavy-duty aluminium pen tray in length as shown on the Drawing with plastic endcap for both ends. GMS “L” shape bracket to be provided for conceal wall fastening.

2 Sets of plastic chalk box shall be mounted underneath the bottom of outer frame for storage of chalks and dust.

Porcelain Enamel Steel Surface

Reflectivity should not exceed specified range when tested at 60 degrees with a gloss meter in accordance with **ASTM C 523**.

Contrast & waviness for board surface (Light and Dark Effects) shall be not less than 20 when tested with the contrast measurement test with 773 gram load on chalk.

Resolution (visual acuity) shall be based on 3 lines per degree and be visibly maintained beyond the current standard of 3 meters. [Byk-Gardner measuring device].

Wet ghost measurement on board surfaces before and after wet cleaning shall not exceed a factor of 0.49 (Using a 60 degree gloss meter). Board surface not affected by most strong cleaners and basically non-staining due to non-porous surface.

Surface Harness: Conform to **EN-DIN 101** (Min. 5)

Wear Resistance: Meets **ASTM C 501** (Max. 0.1g)

The surface gloss should be 70% when measured with a 200 –gloss meter according to **ISO 2813**.

Magnetic Whiteboard and Greenboard **22.121*** **Magnetic Whiteboard and Greenboard**

Magnetic whiteboard and Greenboard shall be constructed with 0.4mm thick fired vitreous porcelain enamel steel in white / green colour and glossy finish bond on 18mm honeycomb board with zinc steel backing. The board surface is 100% non-combustible, lead-free and suitable for magnetic attachment of messages.

Magnetic whiteboard and Greenboard shall be surrounded by 20 x 30mm extruded anodized aluminium channel with rounded safety plastic corners. No screws head to be exposed on front side.

Custom-made full height magnetic whiteboard and greenboard in Special Rooms shall be surrounded by concealed square edge system. Edge and corner is to provide perfect sharp, straight alignment. No screws head to be exposed on front side. GMS "L" shape bracket to be provided for conceal wall fastening.

25 x 80mm Non-folding aluminium pen tray in length as shown on the Drawing with plastic end cap for both ends. GMS "L" shape bracket to be provided for conceal wall fastening. Protective film to be covered on the surface of magnetic chalkboard in factory.

Tack Board **22.122*** **Tack Board**

The tack board shall be constructed of hessian fabric with chipboard core on 5mm plywood backing. Perimeter trim to be extruded aluminum channel 25mm x 30mm overall dimension to be fitted around panel with round rubber corner.

Custom-made full height tack board in Special Rooms shall be surrounded by concealed square edge system. Edge and corner is to provide perfect sharp, straight alignment. No screws head to be exposed on front side. GMS "L" shape bracket to be provided for conceal wall fastening.

Hessian Fabric

(a) Flammability: Complies with **BS 5852** (**EN 1021-1** Cigarette) and **BS 5852** (**EN 1021-2**).

(b) Abrasion: In excess of 50000 cycles (800g/121Kpa) Martindale.

(c) Light fastness: 4 – 5 (**BS 1006**).

Entrance mats **22.123*** (a) Proprietary entrance mats with cast in aluminium frame shall be provided at all main entrances to the building. The width of the entrance mats shall be at least equal to the full clear width of the main entrance door(s). The length of the entrance mat shall be at least half of its width. A floor drain shall be provided under the recessed area of entrance mat where it is located in the exterior of the building.

(b) Proprietary entrance mat shall be recess mounted by screw fixing on the self-leveling screed inside the mat well so that the aluminium base frame shall be flush with the finished floor level. The removable entrance mat shall be made of heavy duty extruded aluminium rail with vinyl tread inserts (or a combination of other tread materials as approved by the Supervising Officer) linked together by continuous vinyl spline and cushion that shall allow dirt to drop through and be safely retained within the mat well and water shall be drained through the floor drain.

SPORTS EQUIPMENT

Basketball Goal and Backboard System **22.124*** **General**

The basketball goal and backboard system shall be ceiling mounted, forward folding, electrically and manually operated backstop with backboard, goal, winch, height adjuster, backboard edge padding and net.

The System shall include the supporting frame, framing of board, backboard, goals, winches, accessories, wireless remote operator and electrical works for basketball backstop assemblies which shall be products of a single manufacturer.

The System shall be mounted on the steel roof truss and below the false ceiling of the main games arena.

Power source shall be provided.

The whole System shall be designed, fabricated and installed to comply with the latest requirements of International Basketball Federation (**FIBA**), National Collegiate Athletic Association (**NCAA**), National Federation of State High School Associations (**NFSHSA**) standards and major international standards.

(a) Supporting Frame

(i) Structural steel tubing: Steel, mechanical, round tubing conforming to **ASTM A500**.

(ii) Clamps:

(1) Beam clamps: Split-A type with 4516 sq mm minimum beam flange contact area and secured with 2 all thread bolts at each attachment point.

(2) Component attachment clamps: Full surface type fabricated from 6 mm thick steel.

(3) Goal brace: Type attaching behind goal mounting plate and directly to backstop main stem transferring load directly to structural frame.

(iii) Extruded Aluminium: **ASTM B221**, alloy 6063 Temper T5.

(iv) Aluminium castings: **ASTM B85**.

(b) Ceiling Mounted Folding Backstop

(i) Type: Ceiling mounted, forward folding basketball backstop

(ii) Support framework: Backstop mounted to ceiling at four hinged points with two adjustable, rectangular side frames constructed from 64 mm diameter, 2.4 mm thick outer tube and 57 mm diameter, 2 mm inner tube.

(4) Extension adjustment: ±152 mm.

(5) Hinges: Offset type allowing backstop to be positioned flat against wall. Provide 8 hinges for attachment of frames to wall and to backboard.

(6) Cross braces: 38 mm diameter, 3.2 mm thick vertical and diagonal steel tubes for bracing rectangular side frames.

(7) Locking brace: 38 mm diameter, 3.2 mm thick steel tube positioned diagonally between lower side frame tubes to lock backstop into playing position.

(iii) Diagonal support chains: Two 6 mm welded link chains with levelling turnbuckles.

(iv) Wall pads: Provide 50 x 203 mm southern yellow pine pads with chamfered edges and clear lacquer finish for support frame hinge and chain attachment points.

(v) In folded position, a minimum clear height of 9,200 mm from the underside of the backstop to the floor finish shall be maintained.

(c) Electrical Winch

(i) Provide electrical winch with remote control for lowering and raising each folding basketball backstop.

(ii) Type: Sealed-bearing, self-locking, worm-gear type. Winch shall be capable of holding backstop in any position during raising and lowering.

(1) Provide winch with removable handle.

(2) Spool: Designed to lay cable uniformly without stacking.

(3) Motor: Equipped with % horsepower, 220 volt reversing motor with overload protection and key switch included.

(4) Hoist cable: 6 mm diameter, 7 x 19, galvanized aircraft cable with 3175 kg ultimate breaking strength.

(5) Provide 50 x 203 mm southern yellow pine pad with chamfered edges and clear lacquer finish for wall mounting winch.

(d) Safety Belt and Lock

(i) Provide each front and rear folding basketball backstop with safety belt and lock test to withstand 454 kg free fall load.

(ii) Safety lock: Inertia sensitive to automatically lock backstop in position at any time during storage, raising, or lowering. Sudden increase in either tension or speed shall activate lock.

(iii) Safety belt: 51 mm wide nylon belt rated at 2,721 kg breaking strength.

(iv) Belt shall extend 10.7 m and shall be automatically retracted and stored on reel equipped with constant force spring. Operation and locking action shall be activated by centrifugal force to lock backstop before unit travels 3.7 m of free fall.

(v) Unit shall incorporate automatic reset not requiring poles, ropes, levers, or buttons for resetting.

(e) Backboard

(i) Type: Rectangular, glass, official size backboard to be used with direct attachment goal;

(ii) Size: 1829 mm wide x 1067 mm high

(iii) Construction: 13 mm thick fully tempered clear glass in extruded aluminium frame with mitered corners. Provide steel gusset type mounting comer brackets with slots for mounting backboard to support structure.

(iv) Goal mounting assembly: Steel assembly secured to aluminium frame and equipped with steel sleeves through glass allowing rear structure to be secured to front mounting plate. Provide with holes and studs to secure backboard and goal directly to goal brace; front plate provided with holes for goal attachment.

(v) Equip frame and goal mounting assembly with neoprene shock absorbing cushions.

(vi) Permanently etch official white border and target area on front side of

glass.

(f) Goals

(i) Type: Heavy duty, front mounted goal fabricated from steel rod and steel plate;

(ii) Goal shall support 363 kg at outer edge of ring and shall flex downward 70 mm without permanent damage.

(iii) Ring: Fabricated from 16 mm diameter high strength, cold drawn alloy steel rod formed into 457 mm ring. Provide with 12 no-tie net attachment clips welded to ring. Rigidly brace ring with 16 mm diameter high strength steel rod welded to mounting plate.

(iv) Mounting plate: 4.4 mm steel plate bracket with mounting holes and designed to position inside of ring 152 mm from backboard.

(v) Finish: Orange enamel or continuous no tie net attachment with orange powder coated finish

(vi) Anti-whip net: Top half made of durable fibres encased in nylon to prevent net from whipping up on rim. Lower half all nylon. Colour white.

(vii) Nylon net and hardware shall be included.

(g) Height Adjuster

(a) Type: Mechanism for manually adjusting height of rectangular backboard and goal;

(b) Adjustment range: Goal position from 2,438 to 3,048 mm above court floor.

(c) Construction: Steel angle frame attaching to backboard, double slip tube guide assembly, clamp type connectors, and other required attachment hardware.

(d) Operation: Provide 32 mm acme threaded rod and nut assembly, timken bearing, and crank for manual operation.

(h) Safe Edge Padding

Type: Foam padding for bottom edge and comers of backboard to provide safety protection to meet **FIBA, NCAA** and **NFSHSA** requirements.

PE foam post padding at 2m (h) should be applied to all posts when applicable.

(i) Accessories

Provide backstop hangers, clamps, brackets, fasteners, and all other hardware required for complete, functional, rigid assembly and installation of backstop.

Volleyball Pole Ground Socket **22.125***

(a) Volleyball equipment system shall be aluminium for its uprights and comprise the following items:

(i) Aluminium winch end upright;

(ii) Aluminium centre upright;

(iii) Aramid fibre net packet, 1 meter high;

(iv) Antennae package; and

(v) Upright end pads

(b) The volleyball equipment system shall meet the latest **FIVB, USAV, NCAA** and major international standards.

(c) aluminium cover plates and ground socket shall be provided to receive the uprights of the volleyball system.

(d) Aluminium cover plates of 170mm outer diameter with heavy-duty steel sleeve, 23mm deep, to receive 76mm to 89mm outer diameter uprights shall be provided. The cover plate shall be flush with the sports flooring system and non-slippery.

(e) Sample of floor plate and sleeve shall be submitted in advance for acceptance and for the setting out of sleeves and the related box-out work during casting of concrete slab.

(f) Centres of the floor plates shall be marked out according to the dimensions indicated. Mark also the centre of the volleyball court as shown on the drawings. Court layout dimensions in FIVB standards shall be used as a guide for locating the floor plates.

Court Divider System **22.126*** Electric court divider system shall include supporting frame, curtain winch, a vinyl curtain, wireless remote operator and all electrical works.

(a) Supporting frame

(i) The System shall be mounted on the steel roof truss and above the false ceiling.

(ii) For supporting frame above the false ceiling, frame members shall be 3-12” dia. horizontal and 2-3/8” dia vertical structural tubing. Intermediate supporting members are required for spans exceeding 10’.

(iii) The frame shall be in standard black finish.

(b) Curtain Winch

(i) The curtain is operated by electric curtain winch through system control keypad.

(ii) The curtain winch shall drive a continuous 5” dia. drive pipe.

(iii) Drive pipe power mechanism shall consist of a 1 H.P., 220V AC, 50 cycle, single phase reversible capacitor motor with built-in thermal overload protection.

(iv) The curtain shall be lifted by means of aircraft cable. Lift cables shall be spaced at no greater than 10’-0” centre to centre.

(v) The cradle assembly housing the curtain winch shall be in standard black finish.

(c) Curtain

(i) The curtain shall be approx. 30m wide x 1 1.5m high. Curtain shall stop at 50.8mm above the finished floor. A margin of at least 2m width shall be allowed on both sides of the net for the basketball court.

(ii) Upper portion of the curtain shall be 9 oz/yard vinyl coated polyester mesh. Lower portion shall be 18 oz/yard vinyl sheet. A 6” wide padded pocket shall be formed in the bottom edge of the curtain to accommodate a 1-5/8” dia. bottom round batten. Seams shall be electronically welded

with a full contact weld.

(iii) The curtain shall be flammability rated as self-extinguishing by the California state fire code and class A rated in accordance with Requirement of **NFPA 101**.

(d) Electrical Works

(i) Power source shall be provided:

(a) All electrical works between such power source and the backboard.

(b) The control panel and the associated electrical works between the backboard and the control panel which shall be located in the Main Games Arena and repeated control in the Control Room.

(e) Remarks

(i) All other electrical and mechanical fixtures shall not obstruct the operation of the dividing net.

(ii) Elevated and transportable working platform suitable for installation work at ceiling level shall be provided.

Spectator Seats **22.127*** (a) General

(i) The finished work shall be clean and free from damage and defects. No fixing screws shall be exposed. No part of the finished seating system shall contain sharp edge that will allow cut to installer, maintenance people, or audience. To be safe guarded with no finger or clothing entrapments. Where the system consists of continuous support on which more than one seat is mounted, seat pans should be able to be replaced or remounted individually.

(ii) The seats should be securely fixed onto its supporting system which in turn should be securely fixed, or anchored, with locking devices onto the floor/wall.

(iii) Unless otherwise specified, all materials shall be of the best quality of the types specified. All fasteners shall be non-corrosive.

(iv) Materials, system, and installation shall be robust and weather resistant.

(v) There should be a numbering plate at each seat for identification of seat number and row number.

(b) Seats

Seats shall be factory made and by one of the ISO accredited manufacturer. Seats shall:

(i) Be ergonomically designed;

(ii) Be equipped with a backrest and lumbar support to ensure absolute comfort for the spectator together with a stiffening rib system to ensure high resistance;

(iii) Be shock-resistant;

(iv) Be UV resistant;

(v) Be non-combustible and comply with **BS 5852** Fire Retardant test;

(vi) Equipped with tip-up mechanism;

(vii) Seating Shell shall be:

- Gas Injection moulded H.D.P.E
- Contained UV stabilizers to prevent from discoloration
- Seat has a spring return mechanism
- Strength & stability is certified to **BS EN12727**, test level 4.
- Without armrest

(viii) Dimensions:

- Centre to centre: minimum 485mm
- Overall depth: 550mm (210mm at tip-up position)
- Overall height: 835mm

(ix) Riser Mount Structure
- Seat and backrest are made of high impact nylon6.
- Rail is extruded aluminium
- Leg fabrications are made from steel and powder coated for indoor applications.

(x) As for retractable seating system seats, aluminium bench with powder coating shall be used.

Manual Operated Retractable Bleacher **22.128*** The seating system shall comprise of multi-tiered rows of seats, deck components, handrails, guard rails and risers on retractable supporting understructure and a portable power assist as detailed below.

(a) System Design Criteria

Platform seat assembly; Design to support and resist, in addition to its own weight, the following forces:

(i) Platform loading : 5kN/m^2
(ii) Horizontal and side loading : 6% of vertical load.
(iii) Minimum load at top of rail : 0.75kN/m uniformly distributed load
(iv) System shall be complied with **EN 13200-5**

(b) Frame Structure

(i) Wheel Cover: Wheel cover (f[l 10*60*1 10 3mm thickness) shall be designed and produced specially for making maximum stability of system. The wheel cover shall be assembled to the supporter (100*50*3.1mmT).

For the maximum load distribution from system to the floor, the size of wheel must be ol27*37mm. Each column foot is equipped with more than 4 pcs of wheels with 37mm non- marring soft rubber face to protect wood or synthetic floor surface. To operate the wheel easily, 2pcs of ball bearing must be used for a wheel.

(ii) Row to Row locking: Frames are interlocked at both top and bottom to prevent disengagement and to transmit sway forces. Cantilever shall engage with a guide roller. For the straight operation of the system, 2 guide rollers shall be located at the deck frame. The guide roller is equipped with 2 rollers to prevent twist.

(iii) Girder support: 4 pcs of girder supports are used per deck. This girder support prevents the system over travel when opening or disengagement in use.

(iv) Sway Bracing: Inclined (50*50*2mmT) and horizontal (40*40*2mmT) bracings are positively secured to rear risers to prevent later shift under load.

(v) Deck Support: Securely captures decking for entire length of section.

(c) Deck System

(i) Section Lengths: Each bank shall contain sections not to exceed 1,680mm in length with a minimum of two supporting frames per row, each section.

(ii) Anti-slip nosing: To provide anti-slip nosing on each steps on the gangway for safety purposes.

(iii) Attachment: Through-Bolted fore/aft to deck stabilizers, and frame cantilevers.

(iv) Decking: Plywood(l 8mmT) will be covered on deck frames and be adhered by silicon resin and fixed with screws. Plywood on deck platform shall be finished with PVC flooring or Carpet.

(v) Intermediate step should be round in corner for safety issue. Any sharp angle for any potential danger to the users will not be accepted.

(d) Seating Arrangement

(i) Manual operated telescopic platforms shall be combined together to form not less than 200 nos. seat count in the Main Games Areana and not less than 300 nos. seat count in the outdoor 7-a-side Hard-surfaced Soccer Pitch.

(ii) Each section of manual operated telescopic platform shall be 3 seating rows and shall be retracted by 2 people. No forklift for the transportation will be allowed.

(iii) In stowed position, the telescopic platforms shall not reduce the safety margin of the ball courts.

(iv) Self-storing end rails are required.

(v) There should be a numbering plate at each section of seating row for identification of row and section number.

The supplier and manufacturer shall provide 3 years warranty for the products and workmanship.

Play Equipment/ Products **22.129*** **Standards**

(a) Play equipment refers to proprietary play equipment.

(b) The play equipment and the use zone/safety margin/impact area allowed for each corresponding play equipment in the designated play area shall fully comply with the latest version of the following international standards:

(i) British Standard Institution: **BS EN 1 176** or

(ii) American Society for Testing and Materials: **ASTM Fl 487-1 1** or

(iii) Other recognised relevant international standard and safety codes subject to prior written consent obtained before submission of the technical/design proposal of the play equipment.

(c) Written statement from the manufacturer of the selected play equipment regarding the age group of the target users for each pieces of equipment shall be provided.

(d) Written statement on the maximum free height of fall (as defined in **BS EN 1176-1**) or the maximum fall height (as defined in **ASTM Fl 292-09** & **ASTM F1487-11**) from the manufacturer on the selected play equipment (inclusive of each component of a composite/modular equipment) shall be provided.

(e) Signage with information in bilingual text and graphics to indicate the age group of the intended users, instruction on the use of play equipment, recommendation on parental guidance/supervision etc. shall be provided outside the IASM area for individual play areas to facilitate comprehension by all potential users including children. All information (with proposed wording and graphics) to be shown on signage and proposed locations of signage in form of shop drawings shall be prepared with the manufacturer's recommendation and submitted for acceptance prior to ordering of each play equipment.

The signage to be provided shall be made of stainless steel plate grade 316 with silkscreen graphics and shall include:

(i) A Playspace Layout Plan,

(ii) Signage of each designated play zone (i.e. Zoning signage) fulfilling the above

(iii) requirements in Item (e), and

(iv) Signage of each individual play equipment fulfilling the above requirements in Item (e).

(f) Play areas and the play equipment selected to cater for children with disabilities shall comply with pertinent requirements such as:

(i) **ASTM F1487-11**: Standard Consumer Safety Performance Specification for Playground Equipment for Public Use,

(ii) **ASTM Fl 951-09b**: Standard Specification for Determination of Accessibility of Surface System under and around Playground Equipment, American Society for Testing & Materials,

(iii) **BS EN 1 176:2017** Playground Equipment and Surfacing,

(iv) **BS1 PD CEN/TR 16467** Playground Equipment Accessible for All Children,

(v) **CPSC Document #325 Public Playground Safety Handbook, Nov. 2010, U.S. Consumer Product Safety Commission (CPSC), Washington, D.C.,**

(vi) DOJ 2010 ADA Standards for Accessible Design (2010 Standards) Section 206, 240, 302, 303, 304, 307, 403, 405, 505, and 1008 Play Areas.

(g) In addition to above, other good practices on Universal Accessibility shall be adopted as far as practicable, such as

(i) **Design Manual: Barrier Free Access**, Buildings Department,

(ii) Universal Accessibility: Best Practices and Guidelines 2004, Architectural Services Department,

(iii) Universal Accessibility for External Areas, Open Spaces & Green Spaces 2007, Architectural Services Department,

(iv) ArchSD Standard on UA Provisions.

(h) The play equipment shall rest on new concrete footings. Surface mounting of play equipment on the concrete base will not be accepted.

(i) Shop drawings showing the design and installation of the play equipment (including the safety margin/use zone/impact area), the signage design, the drainage requirement for the future operation and maintenance of the play equipment and other builder's work requirements shall be submitted for acceptance prior to ordering.

All shop drawings submitted in relation to safety compliance as stipulated in Clause 6.7.22 and 6.7.23 shall be endorsed by a Competent Safety Inspector (CSI). The CSI shall be a Certified Playground Safety Inspector granted by the National Recreation and Park Association, USA, or RPI1 Inspector - Outdoor Annual granted by Register of Play Inspectors International, UK or equivalent.

(j) Valid certification from the accredited international testing laboratory to prove that the play equipment is in compliance with the relevant international safety standards/codes shall be submitted for acceptance before installation.

(k) Checking and inspecting the surfaces, checking levels and drainage and checking for all works necessary for satisfactory installation and maintenance of the play equipment, including dismantling and re-assembling of equipment and its footings/concrete base, e.g. to adjust heights for ground clearance or the level of the base, should be allowed until completion of the Works, or sectional completion of the Works for the concerned phase, if applicable.

Warranty and other requirements

(a) Written confirmation from the manufacturer on the place of origin for manufacturing the play equipment shall be provided. Any subsequent change in manufacturer or place of origin (such as relocation of manufacturing plant) shall be submitted in writing for acceptance before installation.

(b) Upon completion of the Works, provision of maintenance manual and a set of maintenance kit (all in accordance with the manufacturer's recommendations and instructions) and as-built records of the play equipment (with setting out details of the play equipment and the use zone/safety margin/impact area) shall be submitted.

(c) The proprietary play equipment constructed on site shall be free from any defects in material and workmanship. It shall also be suitable for use and capable of performing its proper function without material loss of mechanical properties, structural stability, corrosion and distortion or similar, that will significantly reduce the safety and play value of any single component of the play equipment under normal operational conditions of a normal span not less than 8 years.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 24

EXTERNAL WORKS

SECTION 24
EXTERNAL WORKS

ROAD, CAR PARKS AND PAVED AREAS

Roads, car-parks and paved areas generally **24.1**

The clauses under this sub-heading relate to pedestrian ways, cycle paths, playgrounds and other pedestrian paved areas and also include work in small areas, additional areas and the reinstatement and maintenance of existing surfaces. Where the Works of a more major nature are required and for the construction of roadworks, footways, cycle tracks and paved areas, such work will be specified in accordance with Section 10 on Concrete Carriageways and Section 11 on Miscellaneous Roadworks in the **General Specification for Civil Engineering Works (2020 Edition)**, issued by the Civil Engineering and Development Department, the **Construction Site Safety Handbook** issued by the Works Bureau and any relevant mandatory particular specification clauses in the **Construction Site Safety Manual** issued by the Development Bureau.

Generally unless otherwise specified in Drawings or otherwise approved by the SO, the construction of road, car-parks and paved areas shall comply with the requirements in Section 1 of Highways Department Standard Drawings (Drawing No. H1101 – H1134 latest revision).

For all the clauses and sub-clauses in Section 24 of the **General Specification for Buildings (2022 Edition)**, the **General Specification for Civil Engineering Works (2020 Edition)** shall include the current amendments of the Specification published before the date of the first tender invitation for the Contract.

For all external works that are used as roads, carriageway, car parks or paved areas for the purpose of future handover to the Highways Department for maintenance, such works shall be constructed in compliance with Highways standards as promulgated by the Highways Department.

Precast concrete paving **24.3**

Precast concrete paving shall be as Clauses 6.42C, 18.112 and 18.126. The materials used for precast concrete paving and the construction of precast concrete paving shall comply with Part 7 of Section 11 on Miscellaneous Roadworks in the **General Specification for Civil Engineering Works (2020 Edition)**, issued by the Civil Engineering and Development Department.

Construction of typical construction details for precast concrete unit paving shall be in accordance with Highways Department Standard Drawing No. 1103 latest revision, unless otherwise specified in Drawings or approved by the SO.

For concrete paving blocks in landscape hard work, they shall be in accordance with Highways Department Standard Drawings No. H5101A and H5102A for concrete paving blocks type “A” and “B”, unless otherwise specified in Drawings or approved by the SO.

The product shall contain recycled aggregates, of which the following requirements shall be complied with:

(a) The aggregates shall contain not less than 70% by weight of recycled aggregates;

(b) The recycled fine aggregates shall constitute not less than 40% by weight of the total recycled aggregates. The recycled glass cullet should be included as recycled fine aggregates and should constitute 20% to 25% by weight of the total aggregates;

(c) The recycled aggregates, except recycled glass cullet, shall be of crushed inert construction and demolition materials produced from the crushing plant of the Civil Engineering and Development Department or other local sources approved by the Engineer.

The concrete paving units made of recycled aggregates should conform to all the specifications and requirements as provided in the Contract and as stated in the "Particular Specification (PS) for Precast Concrete Units for Paving" as incorporated in the Appendix A of the **ETWB Technical Circular (Works) No. 24/2004** on "Specification Facilitating the Use of Concrete Paving Units Made of Recycled Aggregates".

Bituminous products generally **24.4**

Bituminous materials for roadworks shall be in accordance with "Section 9 - Carriageways: Sub-base Material and Bituminous Materials" of the **General Specification for Civil Engineering Works (2020 Edition)**, issued by the Civil Engineering and Development Department.

The sub-base material shall contain crushed rock, crushed concrete, clean crushed inert demolition material or recycled glass cullet. The product shall conform to the technical requirement for its intended use as specified in Clause 9.03 of the **General Specification for Civil Engineering Works (2020 Edition)**.

Tack coat **24.5**

Tack coat of anionic and cationic emulsions shall be to **BS EN 13808 & BS 434-1: 2011 + A1: 2016** respectively and of the following types:

(a) Anionic bitumen emulsion, Class A1-40 of Table 1, **BS 434-1: 2011 + A1: 2016**

(b) Cationic bitumen emulsion, Class K1-40 as in Clause 4.2 of **BS EN 13808**

Bituminous base and wearing courses **24.6**

Bituminous base and wearing courses shall be as , Table 9.3 ,Section 9 – Carriageways of the **General Specification for Civil Engineering Works (2020 Edition)** referred to in Clause 24.4 and used in accordance with Table 24.1.

TABLE 24.1
Bituminous base and wearing courses

Nominal size (mm)	Use	Thickness per course	
		Min. (mm)	Max. (mm)
37.5	Coarse base course	60	120
28	Fine base course	50	85
20	Wearing course	40	60
10	Wearing course	20	40

The roadbase material shall contain a maximum of 15% of reclaimed asphalt pavement (RAP) by mass of the total mix.

Subject to the SO's approval, the Contractor may use bituminous wearing course and base course materials incorporating reclaimed asphalt pavement (RAP) for carriageway works. The RAP shall comply with the requirements specified in Clause 9.09(3) of the **General Specification for Civil Engineering Works (2020 Edition)**. Wearing course and base course materials incorporating RAP shall be designed, manufactured, laid and tested in accordance with the requirements for these materials using non-recycled materials or otherwise specified by the SO.

Fine cold asphalt **24.7**

Fine cold asphalt shall be to **BS EN 13108-1** and **BS EN 13108-7**.

Surface dressing **24.8**

Surface dressing aggregate shall be to **BS EN 13043** or RAP referred to in Clause 24.6, subject to the SO's approval.

DEEP BORE WELLS

Well casing	**24.25**	Steel well casing shall be 200 mm internal diameter galvanised mild steel tubing to **BS 879-1** and **BS EN 10216-1** & **BS EN 10217-1** with threaded ends for connection. Thermoplastic tube casing and slotted casing shall be to **BS 879-2** and as shown on the drawings
Well screen	**24.26**	Well screen shall be 200 mm internal diameter hot dipped galvanised bridge slotted well screen from an approved manufacturer with threaded ends for connection.

FENCING AND GATES

Fencing wire	**24.34**	Steel wire for fencing, including chain link and barbed wire shall be to **BS 4102**. (a) Galvanised steel wire. (b) Grade A - Plastic coated galvanised steel wire. (c) Grade B - Plastic coated steel wire.
	24.35	Galvanized wire netting shall be to **BS EN 10223-2**, or **BS EN 10223-4,** or **BS EN 10223-5,** or **BS EN 10223-6** or of approved local manufacture according to design requirements.
Steel fence posts and gates	**24.36**	Steel fence posts and gates shall be constructed in accordance with Section 17.

EXTERNAL WORKS – OTHERS

Anchorage devices and fasteners	**24.39***	Anchorage devices and fasteners shall be provided and embedded in concrete or masonry construction where necessary for securing external fences, railings and gates in-place before construction. Requirement on structural details of metal gates shall refer to the latest version of **PNAP APP-146**.
Security Drop Bar	**24.40***	A robust metal apron should be hung from every drop bar to deter people from entering by crawling below the drop bar. Drop bars shall be provided at vehicle entrance and exit to car park with electronic access device and remote control systems operable from the Building Management Office, guard both, watch rooms or at locations required by the user.
Column guards	**24.41***	Shall be 75 x 75 x 5mm galvanized mild steel angle sections, cast in the concrete, flush with the surrounding finished surfaces and of not less than 1500mm (or to suit the height of servicing vehicles) above adjacent finished floor level to adequately protect the structure against damage from vehicular impact. Column guards shall be finished with approved polyester polyurethane coating system.
Balustrades & railings (Glass balustrade)	**24.42***	Shall be 18mm clear laminated glass balustrades with 10 mm height mirror/hairline/satin finish grade 316 stainless steel top capping and proprietary grade 316 stainless steel handrails system, provide at edges with level differences exceeding 600mm. No glass balustrade should be used next to planting area and at the planter edge. Any fences, railings and gates next to planting area or at the planter edge should allow have opening or grating through which sufficient ventilation for the adjacent planting area is allowed as well as softening effect to the building edge by the plants can be achieved.

Road humps	**24.43***	Shall be provided before all intersections and before the top & bottom of all vehicular ramps. It shall be proprietary product made of tough and abrasion resistant rubber, 400mm(W) x 50mm(H) or 600mm(W) x 75mm(H), in segments and capable of resisting force at 20km/h. Road humps shall comprise alternative contrasting colour segments and fix to concrete slab as per manufacturer's instruction and recommendation.
Stainless steel grating	**24.44***	Stainless Steel grating shall be provided with appropriate loading capacity and sizes for all surface channel, gullies, etc. in external roads and pavement at ground level to the satisfaction. Slip resistance and barrier-free access requirements shall be also considered. Heavy duty grating must be used for areas where vehicular traffic is expected, otherwise medium duty grating shall then be used. The detailed design, including structural and drainage calculations, to be submitted for approval. Where channels intersect with paved pedestrian area, specially designed matching channel cover shall be used.
Manhole covers	**24.45***	Stainless Steel covers and recessed to receive with matching finish and provided with appropriate loading capacity and sizes for all manholes, draw pits, underground services chamber, etc. Heavy duty manhole cover must be used for areas where vehicular traffic is expected, otherwise medium duty manhole cover shall then be used.
Double matching covers	**24.46***	Shall be provided on top of cast iron covers for manholes, sump and cable pits, earth pits, cable trenches, smoke vent (if any) and all other pits. The matching cover should be supported by robust stainless-steel frame with recess for receiving floor finishes matching surrounding area. Eye bolt should be provided for lifting of all manhole and sump pit covers. Double seal edges for covers shall be provided as necessary to avoid ingression of water and release of odour. The whole matching cover and the matching tiles on top should be set out and arranged in the alignment and rotation angle following the adjacent finishes as far as possible.
Flagpoles	**24.47***	Flagpoles shall be aluminium completed with concealed winch system, standing on ground at locations to be specified with exposed height of at least 15m, together with necessary accessories including the ball head or finial. The pole shall be made of aluminum 6063-T6 alloy finished with powder coating of approved color and with exposed height of 15m. The aluminum pole shall be conical and seamless section with lockable door for access to the internal halyard. The flagpole shall complete with an internal halyard system, rope and a golden color finial and aluminum socket at the top of flagpole. No plastic part is allowed to be fixed at the top of the flagpole. Retainer ring consists of galvanized steel counter weight with powder coating and UPVC balls including all necessary connection hardware shall be provided for lowering the flag. The aluminium pole section shall be bonded to a galvanized mild steel mounting stand consisting of GMS tube and base plate by fibreglass. The mounting stand shall be anchored to reinforced concrete footing with 4 numbers of Y16 pre-cast holding down bolt. No. 14 gauge spun aluminium collar to cover bolts shall be provided. Structural calculation and shop drawings of the flagpoles shall be submitted for approval.
Irrigation bollard	**24.48***	The irrigation bollard shall be composed of the following fittings and accessories, or otherwise instructed: -

(a) 1 mm thick stainless steel (grade 316) dome end cap with matt finish bent to shape and welded to frame;

(b) 1 mm thick stainless steel (grade 316) sheet with matt finish bent to shape welded to frame;

(c) stainless steel (grade 316) rod handle with matt finish bent to shape welded to frame;

(d) stainless steel (grade 316) hinge welded to frame;

(e) 5mm dia. key hole on stainless steel (grade 316) cover;

(f) hook lock fixed to frame with master key;

(g) 10x2x220mm long stainless steel (grade 316) flat cover stop;

(h) bracket for water pipe welded to frame;

(i) anti-mould silicone sealant all round the joints between stainless steel sheets and frames; and

(j) concrete plinth (base for installing the irrigation bollard) with 20mm thick external rendering with smooth finish inside and with natural granite flamed finish or other paver laid on soil outside unless as otherwise specified.

External wood plastic composite decking system **24.49***

(a) The proprietary wood plastic composite decking system shall include wood plastic composite with solid profile, end caps, aluminium main frame, sub-frame and all necessary fixing accessories as specified. The wood plastic composite shall be recycled product with Eco-Mark Label.

(b) The wood plastic composite shall contain 55% wood flour and 45% recycled plastic - polypropylene (PP).

The wood plastic composite shall conform to the following performance tests or demonstrate equivalent function or performance in accordance with Table 24.4A*.

TABLE 24.4A*

Physical Properties	**Test Reference**	**Test Results**
Bending Strength	**J1S-Z2101**	98 N/mm²
Length Tensile Test	**K7 113**	Tensile Strength: 29 MPa Tensile Rupture Expansion: 1.2%
Shearing Strength	**JIS Z 2101**	20 N/ mm²
Compression Strength	**JIS Z 2101**	53 N/ mm²
Water Absorption Rate	**JISK 7209**	1 .5%
Slip Resistance	**ASTM E303**	Dry state - To grain right angle: 95 BPN - To grain parallel: 88 BPN Moist state - To grain right angle: 61 BPN - To grain parallel: 55 BPN
Modulus of Elasticity	**JIS Z 2101**	4209 N/ mm2

Physical Properties	**Test Reference**	**Test Results**
Density	**JIS Z 2101**	1.15 g/cm3

Screw Retentively Rate	**JIS A 9505**	3230 N
Wear-out Feature	**JIS Z 2101**	0.052mm
Antiseptic Test for Examination of Bacterium of Cawaratake and Oouzratake	**JIS 9201**	0% (Mass Decreasing Rate)
Ant Prevention Test	**Japan Wood Prevention Society Standard**	100% (Kill Insect Rate) 0 % (Mass Decreasing Rate)
Rockwell Hardness Test	**JIS K 7202**	98 R

(c) The wood plastic composite shall be slip-resistant and unaffected by chlorine or salt water.

(d) The product shall be water and termite resistant and does not promote the growth of mould and mildew.

(e) The decking shall be equipped with the following proprietary sub-frame and fixing system:

(i) The sub-frame or joist shall be in metal material with adjustable pedestal support;

(ii) Proprietary clipping fixing mechanism shall be used instead of nail fixing;

(iii) The fixing mechanism shall be invisible from outside;

(iv) The fixing mechanism shall be reasonably convenient for changing or future maintenance; and

(v) Other necessary accessories, setting block, etc. shall be included.

(f) The decking system shall possess proven local job references, especially on exterior project with similar nature. The information shall be submitted for acceptance.

(g) The system shall be provided with rat control wire mesh with maximum distance of 3m x 3m across the aluminium sub-frame and underneath the wood plastic composite board. The perforation of the wire mesh shall be 10mm maximum for effective rat control.

Non-combustible wood plastic composite ceiling system **24.50***

(a) The proprietary wood plastic composite ceiling system shall include the composite wood trim profile, supporting frame and all necessary fixing accessories.

(b) The composite wood shall be recycled product with Green Label and Eco-Mark Label.

(c) The non-combustible ceiling system shall be a proprietary wood plastic composite containing 55% wood waste and 45% recycled plastic-polypropylene (PP), and with integrally-molded aluminum core.

The composite wood shall conform to the following performance tests or demonstrate equivalent function or performance in accordance with Table 24.5A*.

TABLE 24.5A*

Physical Properties	Test Reference	Test Results
Moisture Content	**BS EN 408**	0.70%
Water Absorption	**ASTM D648**	1 .74%
Formaldehyde Release	**GB 18580**	≤ 0.3mg/E
Bending Characteristics	**JIS K7171**	32MPa
Size Change Rate after Heating	**GB 18580**	± 2.5%
Size Change Rate Different Temperature	**GB/T 8814-1998**	± 0.2%
Heat Deformation Temperature	**JIS K 7191**	116°C
Toxic Substance Elution	**JIS K 6743**	Cadmium < 0.001mg/L Lead < 0.005mg/L Mercury < 0.0005mg/L Selenium < 0.002mg/L
	JIS K 0400-61-10	Arsenic < 0.01mg/L
	JIS K 0400-61-20	Hexavalent chromium < 0.05mg/L
Colourfastness	**AATCC 16E**	> Class 4.0
Nail Withdrawal	**BS 6948**	91.85N
Slip Resistance Value	**CSR measurement**	Dry condition: 0.78 max. & 0.65 min. Wet condition: 0.75 max. & 0.64 min.
Mould Resistance	**Japan Wood Preserving Association Standard No. 3**	0.7%
Durability	**ASTM 790 / BSE6**	Test after 1200 hours: No performance change
Fire Retardant	**BS 476-4**	Passed (test report required)

(d) The product shall be water and termite resistant and does not promote the growth of mould and mildew.

Tree grilles and guards **24.51*** Tree grilles and guards shall be of proprietary metal. The tree grilles shall be of decorative pattern in size of 1.5m x1.5m x 40mm with matching guards of minimum height of 1,200mm above ground.

Fall arrest system **24.52*** (a) General

Fall arrest system shall be horizontal type proprietary fall arrest system complying with EN 795 and consisting of a 8mm diameter (7x7) stainless steel horizontally mounted life-line (H.L.L.) cable and all necessary stainless steel proprietary components and accessories such as fork ends, tensioners, intermediate brackets, energy absorbers and corner units, bolts and nuts. No other equipment shall be used together with the fall arrest system without written permission of the manufacturer.

The fall arrest system shall be designed to safely arrest personnel who accidentally fall at their work place, and therefore it saves lives and minimises injury. Each fall arrest system shall be suitable for 2-person (with a design load of 130 kg per person) operation.

An opening sayflink complete with integral lanyard and shock absorber shall be used for permanently attaching a user to the H.L.L. whilst in the work zone. The opening sayflink shall allow the user to attach or detach themselves at any point along the system.

During system attachment, the user shall be able to walk along the work zone and the sayflink shall glide along the H.L.L., and shall negotiate any intermediate bracket or corner unit automatically.

The fall arrest system should include the personal safety kit (lanyard, harness and carabiners) supplied by the same manufacturer of the system for system compatibility.

(b) Tensioner and fork end

The tensioner unit at one end of the H.L.L. shall be 8mm tensioner made of Grade 316 stainless steel. The tensioner shall serve as an adjustment device used during installation and servicing only.

The fork end at one end of the H.L.L. shall be 8mm termination made of Grade 316 stainless steel for connecting the H.L.L. to the end bracket of the fall arrest system.

(c) Intermediate bracket

The intermediate bracket shall be made of Grade 316 stainless steel. The main part of the bracket shall be fabricated from “one-piece” stainless steel sheet to ensure no potential failure in any welding connection when a fall occurs. The intermediate bracket shall ensure the sayflink sleeve smoothly bypassing the bracket, and it shall deform to dissipate the energy generated by a fall and ensure minimal shock loads imposed on the user when a fall occurs.

(d) Corner unit

The corner units shall be made of Grade 316 stainless steel. The corner unit shall consist of a two main stainless steel guide tubing with brackets. The main part of the bracket shall be fabricated from “one-piece” stainless steel sheet to ensure no potential failure in any welding connection when a fall occurs. The corner unit shall allow the sayflink sleeve to follow the contours of the buildings, and it shall deform to dissipate the energy generated by a fall and ensure minimal shock loads imposed on the user when a fall occur.

(e) Design of fall arrest system

The H.L.L. shall span the work zone, the extremities being connected to the building or installation structure by anchorages at a suitable spacing. The system shall be able to resist a dynamic peak of 7kN. Design calculation and layout plan with details of the fall arrest system shall be submitted to the Project Manager for approval. An output of fall-simulation analysis (from manufacturer’s approved programme) of each complete fall arrest system including system span, bracket spacing, quantity of intermediate bracket and corner unit, etc. shall be attached together with design calculation during submission.

(f) Harness and lanyard

Harness - Two sets of full body harness with front and back D-rings shall be provided for each fall arrest system. The full body harness shall comply with **BS EN 361**, and it shall ensure that the forces generated during a fall are distributed over the shoulders, chest and thighs, and minimises jack-knifing of the body. It shall also ensure that after a fall the wearer is supported in the head up position.

Lanyards - Two sets of shock absorbing lanyard complying with **BS EN 354** and **BS EN 355** shall be provided for each fall arrest system. The length of the lanyard shall not exceed 2m to minimize the falling distance.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 25

LANDSCAPE WORK

SECTION 25
LANDSCAPE WORK

EARTHWORKS AND SOILING

Decomposed granite (DG) **25.4** Imported DG shall be friable, fine grained decomposed granite free from all impurities and other deleterious materials including chemicals, oils, cement, concrete, sticky clay and stones exceeding 25 mm diameter.

Sand **25.9** Sand shall be clean, sharp graded agricultural or horticultural sand 4 mm down to dust and not collected in brackish water marine environment.

Alginate **25.11** Alginate shall be organic, derived from seaweed as soil improver, to be incorporated into the top 300 mm of soil during cultivation, when directed by the SO.

Soil stabilizer **25.12** Soil stabilizer shall be an approved proprietary type of binding medium applied in an aqueous suspension by spraying onto the surface of the soil to prevent short term erosion and to condition the soil. The binding agent shall not be injurious to plant growth.

Stone chips **25.13** Stone chips shall be clean, sharp graded suitable for horticultural use 4 – 2 mm, with no weed growth, free of other foreign matter or contamination, and not collected in brackish water marine environment.

Fertilizer generally **25.16** Fertilizers shall be chemical compounds stored in waterproof sealed bags off the ground under shelter, away from direct sunlight and protected from exposure to conditions (such as temperature and humidity) which may adversely affect the fertilizer.

Pre-planting fertilizer **25.17** Pre-planting fertilizer shall be an approved granular slow release compound comprising Nitrogen (N) Phosphorus (P) and Potassium (K) and trace elements in the ratio: 15:9:15:2.

DRAINAGE

Drainage aggregate **25.41** Aggregate shall be:

(a) Clean, rounded stone, 25 – 50 mm diameter, and

(b) Free from weeds, other building materials, foreign matter and contamination.

Drainage aggregates, if so instructed by the SO, shall be subjected to sieve analyses to **BS EN 933-1**.

Lightweight aggregate **25.42** Lightweight aggregate shall be clean clinker, or equal and approved, 20-50 mm in diameter, weighing a maximum of 500 kg/m^3 when compacted.

Filter layer **25.43** Filter layer shall be a permeable non-woven, thermally bonded geotextile filter fabric, which is not affected by acids, alkalis, bacteria, humidity, or rotting, and shall meet performance requirements set out in Table 25.1 in sound performance for minimum 12 years.

TABLE 25.1
Types of Filter Layers

Type	Properties	Test Method	Acceptance Standards (±10%)

A	Mechanical Properties (i) Wide width strip tensile - Mean peak strength - Elongation at peak strength - Strength at 5 % strain (ii) CBR puncture resistance - Mean peak strength	**BS EN ISO 10319** **BS EN ISO 12236**	 3.0 kN/m 35 % 1.3 kN/m 525 N
	Hydraulic Properties (i) Pore size - Mean AOS O_{90} (ii) Permeability - 5cm head	**BS EN ISO 12956** **BS EN ISO 11058**	 300 µm 150 L/m^2/s

Type	Properties	Test Method	Acceptance Standards (±10%)
B	Mechanical Properties (i) Wide width strip tensile - Mean peak strength - Elongation at peak strength - Strength at 5 % strain (ii) CBR puncture resistance - Mean peak strength	**BS EN ISO 10319** **BS EN ISO 12236**	 6.0 kN/m 25 % 2.6 kN/m 1050 N
	Hydraulic Properties (i) Pore size - Mean AOS O_{90} (ii) Permeability - 5cm head	**BS EN ISO 12956** **BS EN ISO 11058**	 180 µm 130 L/m^2/s
C	Mechanical Properties (i) Wide width strip tensile - Mean peak strength - Elongation at peak strength - Strength at 5 % strain (ii) CBR puncture resistance - Mean peak strength	**BS EN ISO 10319** **BS EN ISO 12236**	 8.0 kN/m 28 % 3.4 kN/m 1500 N
	Hydraulic Properties (i) Pore size - Mean AOS O_{90} (ii) Permeability - 5cm head	**BS EN ISO 12956** **BS EN ISO 11058**	 150 µm 100 L/m^2/s

PLANTING - GENERAL

Slow release fertilizer **25.57** Slow release fertilizer shall be granular NPK chemical fertilizer with a minimum four (4) month release period at 32ºC with the following formula:

14 - 18	parts N	(Nitrogen)
7 - 14	parts P_2O_5	(Available Phosphoric Acid)
12 - 16	parts K_2O	(Soluble Potash)
max. 2	parts MgO	(Magnesium Oxide) plus other trace elements.

Quick release fertilizer **25.58** Quick release fertilizer shall be granular NPK chemical fertilizer with a minimum two (2) week release period at 32ºC with the following formula:

14 - 16	parts N	(Nitrogen)
14 - 16	parts P_2O_5	(Available Phosphoric Acid)
14 - 16	parts K_2O	(Soluble Potash)

Protective fencing for planting works **25.63** Protective fencing for completed planting works shall be proprietary-make bamboo fence comprising the following characteristics:

(a) 600 mm or 900 mm high.

(b) 10 – 20 mm diameter bamboo palings fastened together at each joint with galvanized metal staples and washers, which when erected forms a framework with palings at 150 mm centres.

(c) The fence shall be fixed with rot proof wire to vertical metal stakes comprising 1200 mm long for 600 mm high fence or 1500 mm long for 900 mm high fence, driven 600 mm into the ground at 2000 mm centres.

(d) The metal stakes as detailed above shall be painted black with one primer coat and one finishing coat before installation. All edges of the stakes above ground level shall be smooth.

Wound sealant **25.64** Sealant shall be a proprietary type tree wound dressing that is emulsion formulated and non petroleum based. The dressing shall remain flexible after drying and withstand all weather conditions for arboricultural use in subtropical climate. The sealant shall be approved by the SO prior to application.

Metal stakes **25.65** Metal Stakes shall be 40 x 40 x 4 mm thick GMS angle-iron painted with one coat of approved primer and one coat of approved finishing coat prior to installation. Height of stake shall be 1800 mm or as specified to suit height of plant being supported.

All sharp edges of the metal stakes shall be removed to avoid damage to the plant.

The primer and finishing coat shall be approved by the SO prior to application.

Bamboo stakes **25.66** Bamboo stakes shall be minimum 50 mm diameter bamboo poles and 1500 mm high to suit the height of the plant being supported. All exposed ends shall be properly dressed and finished.

Ties **25.67** Ties shall be either of the following which shall be capable of adjustment after fixing, and shall be fitted with flexible rubber or plastic sleeves to prevent chafing, rubbing or abrasion of the plant. Ties shall be of dark colour.

(a) 5 mm diameter rot-proof and non-abrasive rope with low moisture absorbent rate;

(b) 3 mm diameter plastic coated wire with 20 mm adjustable galvanized steel screw clamp;

(c) 3 mm diameter stainless steel braided wire with 20 mm adjustable stainless steel screw clamp.

Guys **25.68** Guys shall be fitted with a flexible rubber or plastic sleeve to prevent chafing, rubbing or abrasion of the plant, and a 100 mm long stainless steel turnbuckle for adjustment. Guys shall be one of the following:

(a) Multi-strand twisted stainless steel wire of between 4 mm and 6 mm diameter with 20 mm adjustable stainless steel screw clamp.

(b) 8 mm diameter rot-proof rope in dark green, dark brown or black colour;

(c) 4 mm overall diameter plastic coated wire in dark green, dark brown or black colour.

Guying stakes **25.69** Guying stakes shall be 25 x 25 x 5 mm thick galvanized mild steel angle with 5 – 10 mm diameter hole drilled 30 mm from the top prior to galvanizing, painted

with one coat of approved primer and one coat of approved finishing coat prior to installation.

Trunk Protection **25.70** 10 mm diameter clear unplasticised polyvinyl chloride (uPVC) hosing shall be used as guy cover and trunk protection hosing; 2 mm thick and 150 mm wide flexible rubber pad long enough to wrap twice round the trunk to be used as trunk protection.

Root barriers **25.71** Root barriers shall be a proprietary type of high-strength, non-toxic, non-woven fabric specifically designed to stop vigorous root penetration of tropical and subtropical trees and shrubs. It shall not be embodied with any chemical substance that is harmful to health of the trees and shrubs or will cause any pollution to the environment.

(a) For application around tree pits, it shall have the following mechanical properties**:**

Mechanical Properties	Test Method	Acceptance Standards (±10%)
Wide width strip tensile	**BS EN ISO 10319**	
- Mean peak strength		3.0 kN/m
- Elongation at peak strength		35 %
- Strength at 5 % strain		1.3 kN/m
CBR puncture resistance		
- Mean peak strength	**BS EN ISO 12236**	525 N

(a) For application on roof top, it shall be of a proprietary type, in a completed assembly, serving multiple functions of tree root barrier, water retention and drainage layer systems, and with cushioning properties to protect the substrate (such as roofing / water-proofing membrane).

Control of pests, fungal infestation and disease **25.74**

~~(a) At all times during the construction period and Establishment Works period, the Contractor shall take all necessary measures to protect and/or treat the Site (including existing vegetation, preserved trees and all other Landscape Softworks) from pest, fungal and disease attack and all necessary control measures to eradicate pests, fungi and disease from the infected/infested plants and/or areas. The precautionary, preventive and control (inclusive of treatment and eradication) measures shall be carried out, in accordance with Clauses 25.74(b) to (e) and 25.94.~~

~~(b) The Contractor shall regularly check for any insect attack or fungus infestation particularly during known periods of activity.~~

~~(c) Report immediately to the SO any such occurrence and carry out remedial measures by the use of the appropriate pesticide, insecticide or fungicides and any other necessary chemical treatment and associated arboriculture works to the infected and / or infested areas, as approved by the SO. The Contractor shall comply with the following requirements in applying the pest, fungal and disease control measures:~~

~~(i) Environmentally friendly measures shall be adopted, and use of biological control agent shall not be allowed at any time,~~

(ii) All pesticides, which include insecticides, miticides, herbicides, fungicides and any other chemicals to be used on plants to treat infection, shall be a registered pesticide under the **Pesticides Ordinance (Cap. 133)**, and non-injurious to plant growth,

~~(iii) Safety precautions as the manufacturer's instruction and statutory requirements shall be strictly followed in storing, handling and~~

~~applying pesticides, insecticides, fungicides and chemicals so as to prevent unnecessary dispersion to protect the safety of workers and to avoid causing danger or harm to the public and the environment,~~

(iv) Proposed type and Material Safety Data from the manufacturer shall be submitted for approval ~~before~~ application, and

~~(v) Plant parts pruned from diseased plants shall not be stockpiled anywhere on the Site and shall be disposed of from the Site.~~

~~(d) Upon announcement by the Agriculture, Fisheries and Conservation Department (AFCD) on any quarantine pests or when instructed by the SO, the Contractor shall:~~

~~(i) Immediate check for any pest infestation and report to the SO;~~

~~(ii) Complete the report within seven days of receiving the announcement by AFCD and/or such instruction by the SO;~~

~~(iii) Submit method statements for the control measures to the SO for approval before commencement any work in association with the control measures.~~

~~(e) When discovered within the Site, the following species in particular shall be dealt with immediately in accordance with Clauses 25.74(e) and 25.94.~~

~~Scientific Name~~	~~English Common Name~~
~~*Solenopsis invicta Buren*~~	~~Red Imported Fire Ant (RIFA)~~
~~*Rhynchophorus ferrugineus* Oliv.~~	~~Red Palm Weevil~~
~~*Quadrastichus erythrinae* Kim~~	~~Erythrina Gall Wasp~~

PLANTING - TREES, SEEDLINGS, WHIPS, LIGHT STANDARD, STANDARD, HEAVY STANDARD, SEMI-MATURE, CONIFERS, PALMS, LARGE PALMS, SMALL PALMS AND CYCAS

Supports for non-self- clinging climbers **25.114** Supports for non-self-clinging climbing plants to consist of either:

(a) 1 or 2 no. vertical bamboo poles, 15 – 20 mm diameter x 1000 mm minimum height above ground and 250 mm below ground.

(b) 3 no. bamboo poles 15 – 20 mm diameter, 1000 mm minimum height above ground, spaced and tied to 3 or 4 cross bamboo poles 10 – 15 mm diameter to form a triangular shaped support frame. Rot proof ties shall be used to fix bamboo securely together.

PLANTING – GRASS

Seed **25.123** An approved laboratory shall mean one of the Employer's laboratories or an Accredited Laboratory.

All seed shall be true to species and laboratory tested. No seed shall be used unless covered by an appropriately numbered seed analysis report or certificate. The numbered reports or certificates shall always refer to the number on the seed containers. The origin of all seed and the name of the supplier shall be stated on the seed containers.

The quality of grass seed shall be gauged by purity, germination percentage and freedom from weeds. The total weed seed content shall not exceed 0.5% by mass and the total content of other crop seed shall not exceed 1% by mass.

Certificates of seed **25.124** Provide a certificate of testing for each species of seed from an approved laboratory or supplier, stating:

(a) Grass species and variety using scientific names;

(b) Date of testing (should not be more than 6 months before the date of use of the seeds);

(c) Test result on the percentage germination of pure seed in a fixed time under standard laboratory conditions; and

(d) Test result on the percentage composition by weight, including details of purity.

Germination **25.126** The germination capacity of each constituent of a grass seed mix over a seven-day test period shall be at least 80%.

Purity **25.127** The purity of each constituent of the grass seed mix shall be greater than 90%. Total pernicious weed seed content shall be less than 0.5% and total content of other crop seeds shall be less than 1.0%.

Pre-seeding fertilizer **25.129** Pre-seeding fertilizer shall be a quick release fertilizer.

Mulch for hydroseeding **25.130** Mulch for hydroseeding shall be fine grained organic material such as fine ground tree fibre, paper waste and cellulose.

Dye, soil binding agent **25.131** Dye, and soil binding agent shall be of an approved type, non-injurious to plant growth.

Top-dressing **25.132** 65% finely sifted Topsoil or finely sifted Fabricated Soil Mix thoroughly mixed with 35% fine Sand. Marine sand and sand from brackish water shall not be used.

Hydroseeding **25.133** Hydroseeding for Landscape Softworks and the associated Establishment Works shall be carried out by a sub-contractor who is a Specialist Contractor listed on the latest "List of Approved Suppliers of Materials and Specialist Contract" under the category of "Landscaping – Hydroseeding (Class II)" if the Contractor is not included in the said List.

Hydroseeding is the application by high pressure spraying of the specified mixture of grass seed and/or tree/shrub seeds, fertilizer, mulch and other approved additives in aqueous suspension. Hydroseeding shall include the supply of all materials and equipment necessary for the successful establishment of vegetation by the method described.

Particulars of hydroseeding **25.134** The following particulars of the proposed materials and methods for hydroseeding shall be submitted to the SO.

(a) Species and rate of application of grass seed/tree and shrub seed;

(b) Type and rate of application of fertilizer, mulch and soil binder;

(c) Type and colour of dye;

(d) Type of protective fabric material; and

Hydroseeding seed mix **25.136** Hydroseeding seed mix shall be:

		April to August	September to March
Cynodon dactylon (Bermuda grass / Couch grass)		13-15 g/m^2	15 g/m^2
Paspalum notatum (Bahia grass)		8-10 g/m^2	10 g/m^2
Lolium perenne (Perennial Ryegrass)		-	5 g/m^2
Chloris gayana (Rhodes grass)		1- 4 g/m^2 less than 2g/m^2	-
Eragrostis curvula (Weeping Lovegrass)	}	5 g/m^2	5 g/m^2
Eremochloa ophiuroides (Common Centipede-grass)	}		
Cenchrus echinatus (Buffel grass/ Bur grass)	}		
	Total	30 g/m^2	35 g/m^2

Note: Tree/shrub mix refer Clause 25.138.

Hydroseeding solution **25.137** Hydroseeding solution to consist of:

Ingredient	Rate
Seed mix Clauses 25.136 or 25.138	35 g/m^2
Mulch in air-dried weight Clause 25.130	200 g/m^2
Fertilizer Clause 25.129	100 g/m^2
Soil binding agent Clause 25.131	25 g/m^2
Non toxic dye Clause 25.164	0.5 – 0.05 g/m^2
Total	Max. 360.5 g/m^2

Tree/shrub species for hydroseeding **25.138** Tree/Shrub species for hydroseeding:

	Scientific Name	English Common Name
	Tree species:	
(a)	*Alangium chinense*	Chinese Alangium
(b)	*Bridelia tomentosa*	Pop-gun Seed
(c)	*Casuarina equisetifolia*	Horsetail Tree
(d)	*Celtis sinensis*	Chinese Hackberry
(e)	*Eucalyptus robusta*	Swamp Mahogany
(f)	*Gordonia axillaries*	Hong Kong Gordonia
(g)	*Ilex rotunda*	Chinese Holly
(h)	*Litsea rotundifoli*	Oblong-leaved Litsea
(i)	*Lophostemon confertus*	Brisbane Box
	Shrub species:	
(j)	*Melastoma sanguineum*	Blood-red Melastoma
(k)	*Melastoma candidum*	Common Melastoma
(l)	*Melastoma dodecandrum*	Twelve-stamened Melastoma
(m)	*Rhaphiolepis indica*	Hong Kong Hawthorn
(n)	*Rhodomyrtus tomentosa*	Rose Myrtle

(o)	*Rhus chinensis*	Sumac
(p)	*Rhus hypoleuca*	Sumac
(q)	*Rhus succedanea*	Wax Tree

Protective layer **25.139** Protective layer shall be non-toxic, biodegradable, porous, translucent, and be 1mm or less thick, cellulose netting. It shall be a proprietary type of degradable fabric with effective certificate issued by the manufacturer and approved by the SO. The fabric shall not degrade within 100 days after application or until the specified grass cover has been established.

Hydroseeding cover **25.140** Hydroseeding shall achieve a cover by grass species of at least 90% of the surface area for each 10 m^2 of the area to be hydroseeded within 28 days after the area has been hydroseeded. The grass cover shall be healthy, vigorous and free from perennial and other weeds.

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 26

GEOTECHNICAL WORKS ON SOIL AND ROCK SLOPES

SECTION 26
GEOTECHNICAL WORKS ON SOIL AND ROCK SLOPES

ROCK SLOPE TREATMENT WORKS

Sealing and infilling of rock joints **26.9**

(a) Seal joints in rock faces with Grade 20/20 concrete, cement mortar or masonry as stated in the Contract. Rock for masonry infilling shall be bedded in cement mortar. Install relief drains instructed by the SO before rock joints are sealed or infilled.

(b) The extent of rock joints and depth of materials in rock joints to be excavated prior to sealing and infilling shall be as directed by the SO.

Concrete buttresses **26.10**

(a) Concrete for buttresses shall be Grade 20/20 unless otherwise stated in the Contract.

(b) Drainage which is required behind buttresses shall consist of relief drains connected to 50 mm diameter uPVC outlet pipes laid at a gradient of at least 1 in 50. Fix the uPVC pipes securely to the formwork before concreting starts.

Fixing protective mesh for slopes **26.11**

~~Orient, lace, suspend down and fix protective mesh for slopes onto the slope face with dowels at intervals not exceeding 3 m in accordance with the details as shown on the Standard Drawing in **Appendix 1**. Position the last column or row of dowels fixing the edges and base of the protective mesh not more than 300 mm from the respective edges/base of the mesh. Avoid laps in vertical mesh sheets as far as possible. Where necessary, laps between vertical sheets shall be at least 300 mm minimum and the lapping sheets shall be laced in the same way as adjacent vertical sheets as shown on the Standard Drawing in **Appendix 1**.~~

Protective mesh for slopes shall be PVC coated galvanized steel wire woven into a double twist hexagonal mesh comply with **BS 4102**. Each hexagon shall be 80 mm × 60 mm. The steel wire shall be at least 2.2 mm diameter and the PVC coating shall be at least 0.4 mm thick. PVC coating on steel wire shall comply with **BS 1722-16** or equivalent. The colour of PVC coating is to be approved by the SO. Wire for protective mesh shall comply with **BS 1052**. Galvanized coating on wires shall comply with **BS EN 10244-2**. The tolerance on the opening of mesh shall comply with **BS EN 10223-2**. Tying wire for protective mesh shall be 2.2 mm diameter PVC coated galvanized soft annealed steel wire. Bolts for fastening protective mesh to rock or structure shall be galvanized mild steel hooks. Anchor bolts and accessories for fastening protective mesh to soil nail head shall be of stainless steel Grade A4 to **BS EN ISO 3506-1** and **BS EN ISO 3506-2**. Hooks, fixing pins, steel plates and washers for fixing the protective mesh to slope face shall be galvanized to **BS EN ISO 1461**.

Colour pigment in sprayed concrete **26.19**

(a) ~~Where ordered, mix colour pigment approved by the SO thoroughly with the sprayed concrete mix, and apply a layer of 25 mm thick of the coloured sprayed concrete to form the total thickness stated in the Contract.~~

(b) Submit details of the colour pigments (e.g. specification and colour samples etc.) and the method statement for the approval of the SO prior to application. The pigment shall comply with **ASTM C979/C979M** and shall have the characterization of light fast, lime proof, weather resistance and durability like concrete. Colour to be employed shall be directed by the SO.

ROCK DOWELS

Rock dowels **26.29**

Rock dowels shall comply with **CS2** and shall be cut in accordance with **BS 8666** to the specified shapes and dimensions. Rock dowels shall be properly handled and stored as stated in Clauses 26.35 and 26.36, and the surface conditions shall be as

stated in Clause 26.38. Rock dowels shall be galvanized to **BS EN ISO 1461** and if damaged, shall be repaired as stated in Clause 26.39. The name and location of the galvanizing factory shall be submitted to the SO for approval. Provide the approved galvanizing factory's certificate showing that the galvanized coatings comply with the requirements including the test results carried out for thickness of coating. Rock dowels shall have non-corrodible centralizers capable of ensuring an even annulus of grout around the steel bar to the approval of the SO. ~~A typical layout of rock dowels is as shown in **Appendix 3**.~~

Grout for rock dowels **26.30** Grout for rock dowels shall be as stated in Clauses 26.52 to 26.62.

SOIL NAILS

Materials **26.34**

(a) Soil nail bars shall be of Grade 500B ribbed steel reinforcing bars to **CS2**. Dimensions, mass per metre and permissible deviation of soil nail bars shall refer to **CS2** Clause 1.4. Chemical composition and mechanical properties of soil nail bars shall refer to **CS2** Clauses 1.5 and 1.6 respectively. All steel components for soil nails shall be galvanized to **BS EN ISO 1461** and materials for repair to galvanized coating shall comply with **BS EN ISO 1461**. The name and location of the galvanizing factory shall be submitted to the SO for approval. Provide the approved galvanizing factory's certificate showing that the galvanized coatings comply with the requirements including the test results carried out for thickness of coating.

(b) Steel reinforcement for soil nail heads shall be Grade 500B ribbed steel reinforcing bars to **CS2**.

(c) Nuts shall be of Grade 4 steel and comply with **BS 4190**.

(d) Reinforcement connectors shall be of a proprietary type approved by the SO and shall be of type 1 mechanical couplers conforming to the **Code of Practice for Structural Use of Concrete**. The connectors shall be capable of developing the full tensile strength of the parent bars.

(e) Bearing plates shall be of Grade S275 steel plate and comply with **BS EN 10025-1** and **BS EN 10025-3**. Steel plates for pull-out and performance tests shall be square with length not less than 300 mm and ratio of length to thickness not larger than 10. Holes in steel plates for soil nail heads shall be drilled perpendicular to the face of the steel plate and centre of the hole shall be at a position of within 2 mm from the centroid of the plate. The clearance between the steel bar and the hole of the steel plate shall not be more than 2 mm.

(f) Concrete for soil nail heads shall be grade 30/20 or 30 MPa sprayed concrete and shall comply with Clauses 26.12 to 26.28.

(g) Soil nails shall have non-corrodible centralizers capable of ensuring an even annulus of grout around the steel bar. The nominal diameter of the centralizers shall not differ from the specified diameter of the drillhole by more than 10 mm. Wires and ties for fixing and anchoring packers, centralizers and grout pipes etc. shall be made of non-corrodible materials. Determine the spacing of the centralizers and the suitability of the method of fixing the centralizers, grout pipes and corrugated sheathing where required by carrying out trials on site until no damage, deformation and displacement of the centralizers, grout pipes and corrugated sheathing are observed on completion of assembling all components, during inserting and withdrawing the soil nails. Once approval is given, no change to the type, method and arrangement of fixing of the centralizers, grout pipe and corrugated sheathing shall be made without the prior approval of the SO.

(h) For soil nails using threaded type reinforcement connectors but without galvanized coating on either the threads inside the connectors or the threads at the ends of reinforcement bars, use heat-shrinkable sleeve of a proprietary

type as approved by the SO as an alternative to galvanization as a corrosion protection measure to the connections. Clean thoroughly any rust on the threads of reinforcement bars and connectors before being connected together.

(i) A typical layout and design of soil nails is as shown in **Appendix 4**.

Soil Nails with Double Corrosion Protection **26.34A***

(i) Corrugated sheathing for the double corrosion protection shall be a proprietary type with proven record for use in similar projects as approved by the Supervising Officer and shall be made of high density thermoplastic materials which shall be homogeneous, thermally stable, chemically inert and resistant to chemical, bacterial and fungal attack. The wall thickness of the sheathing shall be at least 1.0 mm. Plastic sheathing and all associated components shall comply with the requirements as stipulated in Table 2 of the Model Specification for Prestressed Ground Anchors (GEOSPEC 1).

(ii) Finished internal and external surfaces of the sheathing shall be smooth, clean and free of flaws, pin-holes, bubbles, cracks and other defects. Sheathing and all associated components shall be used in accordance with the manufacturer's instructions.

(iii) Sheathing and other plastic protective components shall:

(a) not contain any substances that will promote corrosion;
(b) be covered to prevent exposure to ultra-violet light from direct or indirect sunlight;
(c) be resistant to slip; and
(d) be capable of withstanding the applied handling stresses, the hydrostatic and grouting pressures.

(iv) Centralizers shall be provided on the steel bar and the sheathing at suitable intervals to meet the following requirements:

(a) The steel bar shall be positioned in the sheathing so that a minimum grout cover to the bar of 10 mm is maintained; and
(b) There shall be minimum clearance of 15 mm between the sheathing and the sides of the drillholes or casing.

GROUTING FOR GEOTECHNICAL WORKS

Grout material **26.52**

(a) Cement grout for the drillholes shall consist of cement, sand and water. Obtain prior approval from the SO if admixtures are to be used.

(b) Sand for grout shall be natural sand or crushed natural stone complying with **BS 1200: 2019**, and shall have a particle size distribution such that 100% passes a 2 mm BS test sieve and not more than 30% passes a 0.2 mm BS test sieve.

(c) Water for grout shall be clean fresh water having a temperature not exceeding 30°C or less than 5°C.

(d) Cement grout shall have a minimum cube strength of 30 MPa at 28 days. The water cement ratio shall not exceed 0.45.

(e) The amount of bleeding of grout shall not exceed 0.5% by volume 3 hr after mixing or 1.0% maximum when measured at 23 $\pm$ 1.7°C in a covered glass or metal cylinder of 100 mm internal diameter and with a grout depth of approximately 100 mm. In addition, the water shall be reabsorbed by the grout within 24 hr.

(f) The flow cone efflux time of grout shall not be less than 15 s.

DRAINAGE AND EROSION CONTROL

Relief drains **26.64**

(a) Relief drains shall be drain mats with multi-layer porous fabric wrapped in filter fabric and covered with an impermeable fabric or products having equivalent functions or performance as approved by the SO. ~~PVC flanges for connecting relief drains to outlet pipes shall be as shown on the Standard Drawing in **Appendix 6**.~~

~~(b) Submit the following particulars of the proposed materials and methods of construction for relief drains to the SO:~~

~~(i) Details of relief drains and outlets, and~~

~~(ii) Method of fixing relief drains to the slope face.~~

~~(c) Submit the particulars to the SO for approval at least 14 days before fixing of relief drains starts.~~

~~(d) Submit samples of the relief drain together with the particulars of the material to the SO for approval.~~

~~(e) Construct a trial length of relief drains of at least 2 m.~~

~~(f) Fix relief drains in position before surface protection or remedial measures are applied. Carry out fixing in a manner which will not affect the serviceability of the relief drains or outlets. Discharge water collected in relief drains to outlets agreed by the SO.~~

Granular filter **26.65**

(a) Granular filter shall consist of durable, inert, natural material free of clay, organic material and other impurities. Design granular filter materials in accordance with the design criteria stated in **GEO Publication 1/93 "Review of Granular and Geotextile Filters"** and current amendments.

~~(b) Submit the following particulars of the proposed materials and methods of construction for granular filters to the SO:~~

~~(i) Whether granular filter material is to be supplied ready mixed or is to be mixed on the Site,~~

~~(ii) Source of supply, including name of supplier of ready mixed material,~~

~~(iii) Quantity of each constituent if the material is to be mixed on the Site,~~

~~(iv) Constructional plant and methods of mixing for material mixed on the Site,~~

~~(v) Method of storage and location of storage areas on the Site,~~

~~(vi) Methods of deposition and compaction of material,~~

~~(vii) Results of three tests for particle size distribution of the fill material against which the granular filter is to be placed, and~~

~~(viii) Details of filter design including calculations and grading envelopes.~~

~~(c) Submit the particulars to the SO for approval at least 14 days before deposition of granular filter material starts.~~

~~(d) Submit samples to the SO for approval of the source and type of each material at the same time as particulars of the material are submitted.~~

~~(e) Do not handle or store granular filter material in a manner which will result in mixing of the different types and sizes or in segregation, contamination, deterioration or erosion of the material.~~

~~(f) Place stockpiles of granular filter material on well-drained, prepared areas,~~

and separate them by dividing walls of sufficient height to keep the different materials separate.

(g) Mix thoroughly granular filter material by the method approved by the SO, and remix material which has been stockpiled before deposition.

(h) Compact granular filter materials in accordance with the requirements for rock fill materials as stated in Clause 3.20.

(i) Deposit granular filter material in a manner which will not result in segregation or contamination of the material.

(j) Deposit granular filter material in such a manner that a continuous free draining zone is formed. Clean and scarify the surface of each layer before the next layer is deposited unless otherwise permitted by the SO.

(k) A batch of granular filter material is any quantity of granular filter material of the same type and grading delivered to the Site at any one time.

(l) (i) Provide one sample of granular filter material from each 500 m^3 or part thereof of the material delivered to the Site.

(ii) Unless otherwise permitted by the SO, provide one sample of granular material from each 500 m^3 or part thereof of granular filter material which has been deposited and compacted.

(iii) The size of each sample taken as stated in Clause 26.65(l)(i) shall be 10 kg. The method of sampling shall be in accordance with **CS3**.

(iv) Samples taken as stated in Clause 26.65(l)(ii) shall consist of material excavated from the compacted layer to form a flat bottomed, steep sided hole of approximately 0.13 m^2 to the complete depth of the compacted layer. A template shall be used to fix the edges of the hole if necessary. The sides and bottom of the hole shall be at least 50 mm from other types of fill material.

(m) (i) Test each sample of granular filter material to determine the particle size distribution.

(ii) The method of testing shall be in accordance with the wet sieving method stated in **Geospec 3**, Test Method 8.2.

(n) (i) If the result of any test for particle size distribution on a sample of granular filter material taken as stated in Clause 26.65(l)(i) does not comply with the specified requirements for particle size distribution, provide additional samples from the same batch and carry out additional tests for particle size distribution.

(ii) The batch shall be considered as not complying with the specified requirements for particle size distribution if the result of any additional test for particle size distribution does not comply with the specified requirements for particle size distribution.

(iii) If the result of any test for particle size distribution on a sample of granular filter material taken as stated in Clause 26.65(l)(ii) does not comply with the specified requirements for particle size distribution, provide additional samples from the same batch and carry out additional tests for particle size distribution. The number of additional samples shall be as stated in Clause 26.65(l)(ii).

(iv) The batch shall be considered as not complying with the specified requirements for particle size distribution if the result of any additional test for particle size distribution does not comply with the specified requirements for particle size distribution

(o) Typical details of filter blanket for fill slope are as shown in the Standard

~~Drawing in **Appendix 7**.~~

Geotextile filter **26.66** (a) Geotextile filter shall be a proprietary type approved by the SO and shall have the properties stated in the Contract.

~~(b) Submit the following particulars of the proposed materials and methods of construction for geotextile filter to the SO:~~

~~(i) Manufacturer's name and source of supply,~~

~~(ii) Details of geotextile filter including manufacturer's literature,~~

~~(iii) A certificate for the geotextile filter showing manufacturer's name, the date and place of manufacture and showing that the geotextile filter complies with requirements stated in the Contract, and including results of tests stated in the Contract,~~

~~(iv) Calculations showing that the geotextile filter complies with the filtration characteristics stated in the Contract,~~

~~(v) Details of previous uses of the geotextile filter,~~

~~(vi) Details of quantities to be supplied in each delivery,~~

~~(vii) Method of storage,~~

~~(viii) Methods of cutting and jointing geotextile filter,~~

~~(ix) Method of repairing small batches, and~~

~~(x) Methods of laying and holding in position.~~

~~(c) Submit the particulars, including certificates, to the SO for approval at least 28 days before the first delivery of the geotextile filter to the Site. Certificates shall be submitted for each batch of geotextile filter delivered to the Site.~~

~~(d) Submit geotextile filter sample together with the particulars of the material and two pieces of geotextile filter joined samples in accordance with the manufacturer's recommendations for each type of joint to the SO for approval.~~

~~(e) Deliver geotextile filter in secure wrappings to ensure that the geotextile filter is dry and protected from damage, contamination and exposure to conditions which may adversely affect it.~~

~~(f) Store geotextile filter on a level surface, and keep it in a secure and dry condition, which will not result in damage to the fabric or in contamination of the fabric.~~

~~(g) (i) The total period for which geotextile filter is exposed to daylight or other sources of ultra violet radiation during handling, delivery, storage and installation shall not exceed 7 days.~~

~~(ii) Do not use geotextile filter which has been damaged or exposed to daylight or other sources of ultra violet radiation for longer than the period stated in Clause 26.66(g)(i) in the permanent work unless permitted by the SO.~~

~~(iii) Carry out repairs to geotextile filter which has been torn or damaged during installation using a patch of the same material extending at least 300 mm beyond the edge of the damaged area. Do not carry out repairs on geotextile filter which has been damaged during storage or storage before installation.~~

~~(h) (i) Install geotextile filter in such a manner that the individual yarns, webs or layers of the fabric retain their intended orientation and relative positions with respect to each another.~~

~~(ii) Install, cut and join geotextile filter in accordance with the manufacturer's recommendations.~~

~~(iii) Laps in sheets of fabric reinforcement which are not stated in the Contract to be joined shall be at least 300 mm.~~

~~(i) Do not operate constructional plant and other vehicles on installed geotextile filter, unless in opinion of the SO it is adequately protected by a cover of fill material or other means agreed by the SO.~~

~~(j) Keep records of installation of geotextile filter on the Site, and submit a copy to the SO each day. Records shall contain the following details:~~

~~(i) Identification of structures and sections of work where geotextile filter is installed,~~

~~(ii) Type of geotextile filter, including identification of batch,~~

~~(iii) Date of first exposure of geotextile filter to ultra violet radiation before installation,~~

~~(iv) Type of joint, amount of overlap, method of holding in place and any repairs to geotextile filter carried out during installation,~~

~~(v) Date of installation of geotextile filter, and~~

~~(vi) Date of final covering of geotextile filter.~~

Filter drainage pipe **26.67**

(a) (i) Filter pipes shall comply with the following:

Precast concrete pipes :	**BS 5911-1 & BS EN 1916**
Vitrified clay pipes :	**BS EN 295**
DI pipes :	**BS EN 545**
Steel pipes :	**BS EN 10224**
Perforated concrete pipes :	**BS 5911-1 & BS EN 1916**
uPVC pipes :	**BS EN 1401-1 or BS 3506**
Corrugated polyethylene tubing :	**AASHTO M252-18**

(ii) Do not use Class O uPVC pipes.

(iii) Cut the perforations in perforated pipes clearly, and uniformly space them along the length and circumstance of the pipe.

(iv) Join uPVC plastic pipes using couplers.

~~(b) (i) Submit the following particulars of the proposed materials and methods of construction for filter pipes to the SO:~~

~~(1) Details of type of pipes, including manufacturer's literature,~~
~~(2) A certificate showing the manufacturer's name, the date and place of manufacture and showing that the pipes comply with the requirements stated in the Contract,~~
~~(3) Details of previous installations using similar pipes, and~~
~~(4) Method of installation.~~

~~(ii) Submit the particulars to the SO for approval at least 28 days before installation of the filter pipes starts.~~

~~(c) Submit samples to the SO for approval of the source and type of each material at the same time as particulars of the material are submitted.~~

(d) Store coils of plastic tubing for filter pipes flat.

Erosion control mats 26.68

(a) (i) Non-biodegradable mats for erosion control shall be woven and ultraviolet stabilized mats. The colour of the mats shall be black or dark green or other colour as directed or approved by the SO.

(ii) Biodegradable mats for erosion control shall be woven coir mesh mats or woven jute mats.

(iii) The mats shall have the material properties as stated in the Contract.

(iv) The mats must be produced by proprietary manufacturers and specifically designed for the erosion control of sloping ground.

~~(b) Submit the following particulars of materials and methods of construction for mats for erosion control to the SO for approval at least 14 days prior to installation.~~

~~(i) Details of materials,~~

~~(ii) Manufacture's literature including recommended sequence of mats installation and hydroseeding,~~

~~(iii) Method of lapping, fixing and anchorage,~~

~~(iv) Method of placing and tamping of soft soil into the mats, if required,~~

~~(v) Details of equipment, and~~

~~(vi) A certificate from the manufacturer on the compliance of the materials, as and where appropriate.~~

~~(c) Submit samples of the erosion control mat together with the particulars of the material to the SO for approval.~~

~~(d) Clear areas to be applied with mats of all roots, rubbish, debris and loose soils. All local irregular spots and areas shall be either trimmed or filled with compacted fill material or compacted soil cement to provide smooth surfaces. The finished slope surfaces shall be inspected by the SO prior to installation of mats.~~

~~(e) Lay and fix mats for erosion control onto sloping ground in accordance with the manufacturers recommended procedures and in compliance with the following requirements:~~

~~(i) Anchor the mats except biodegradable types along the slope crest and each berm level with at least 200 mm of mat length embedded into the ground or underneath the concrete berm slabs. The mats shall also be embedded at least 200 mm into any adjacent structures to be constructed. The mats shall be rolled out from top down the slope surfaces. Provide sufficient anchorage pins at a maximum spacing of 1 m centre to centre to ensure the mats are in complete and total contact with the ground at every place. In areas of irregularities due to exposed rocks or existing structures, provide additional anchorage pins to prevent any gap or void forming underneath the mats. Lapping between mats shall be at least 150 mm and shall be formed with the upslope mat over the downslope mat. Do not form lapping within 1 m of any intersection of two slope surfaces which have a sharp difference in slope gradient or strike direction.~~

~~(ii) The biodegradable erosion control mats shall be anchored along the crest of slope and each berm with at least 2 rows of bamboo sticks or wooden pegs at a maximum horizontal spacing of 550 mm on~~

~~300 mm length mat lapping. The mats shall be rolled out from top down the slope surfaces. Sufficient bamboo sticks or wooden pegs at a maximum spacing of 1 m centre to centre shall be provided to ensure the mats are in complete and total contact with the ground at every place.~~

~~(iii) In areas of irregularities due to exposed rocks or existing structures, additional anchorage pins shall be provided to prevent any gap or void forming underneath the mats. Lapping between mats shall be at least 150 mm and shall be formed with the upslope mat over the downslope mat. No lapping shall be formed within 1 m of any intersection of two slope surfaces which have a sharp difference in slope gradient or strike direction.~~

~~(iv) Where recommended by the manufacturer, place and tamp soft soil into the mats and completely fill all void within the mats to form an integral composite structure on completion of laying and anchoring of the mats.~~

~~(v) The sequence of hydroseeding and laying of mats shall be in accordance with the manufacturer's recommended sequence. Lay the protective materials for hydroseeding on top of the erosion control mat, if specified.~~

Raking drains **26.69**

(a) Type 0 raking drains shall be unlined raking drains. Drain holes shall be at least 40 mm diameter.

(b) Type 1 raking drains shall be single pipe raking drains consisting of a single perforated pipe with a non-perforated invert.

(c) Type 2 raking drains shall be single pipe raking drains consisting of a single perforated pipe with a non-perforated invert and enclosed within a geotextile filter sheath.

(d) Type 3 raking drains shall be double pipe raking drains consisting of an outer permanent pipe and an inner removable pipe enclosed within a geotextile filter sheath. The outer and inner pipes shall be perforated pipes with a non-perforated invert.

(e) Pipes for raking drains shall be perforated pipes with non-perforated invert as approved by the SO. A typical layout of raking drain is as shown in **Appendix 8**. The portion of openings in the perforated pipe shall cover between approximately two-thirds 50% and 70% of the circumference of the pipe. The percentage of opening areas to overall surface area of the pipe shall not be less than 14% for 40 mm diameter pipe, nor less than 8% for 65 mm or above diameter pipe. The pipe material shall have the following physical properties or having equivalent functions:

(i) Material: non-metallic

(ii) Minimum tensile strength: 21,300 kN/m^2

(iii) Minimum compressive strength: 22,000 kN/m^2

(iv) Minimum flexural strength: 6,800 kN/m^2

Couplers for filter pipes shall also have non-perforated invert and shall be of similar strength and durability of the pipe materials. The lapped length of coupler and each end of the filter pipes shall be at least 100 mm. The elongation at the pipe connection shall be less than 5 mm under a 45 kg pulling force.

(f) Geotextile filter sheaths for raking drains shall be formed of non-woven geotextile filter robust enough to prevent tearing, and shall have the following physical properties or materials having equivalent functions or

performance as approved by the SO:

(i) Material: non-metallic

(ii) Minimum tensile strength: 17 kN/m

(iii) Apparent opening size: 140 μm

(iv) Coefficient of permeability under 2 kN/m^2: 5 x 10^{-3} m/s

(v) Flow rate at 100 mm head under 2 kN/m^2: 195 L/m^2s

Tying wires for jointing pipes and stitching filter sheath shall be non-metallic wires of minimum breaking load of 400 N or similar approved.

~~(g) Installation of raking drains.~~

~~(i) The length of raking drains assembled before installation shall not exceed 12.5 m. Secure connections between consecutive pipes in such a manner that the cumulative longitudinal extension of a 12.5 m assembled length of pipe does not exceed 5 mm when pulled by hand.~~

~~(ii) Wrap pipes for Type 2 and Type 3 raking drains in geotextile filter sheath in the following manner prior to installation to ensure that the overlap and stitching be located against the non-perforated invert of the pipe. Place the pipe onto and along the centre of a strip of geotextile filter with the non-perforated invert uppermost. Draw the strip of geotextile filter, which shall be of sufficient width to allow an overlap of at least 50 mm, around the pipe and stitched together tightly with non-metallic wires. The stitching shall be tied off onto the pipe and the fabric bound every 300 mm to prevent dislocation during installation. Mark the filter sheath to ensure that the non-perforated invert is correctly positioned during installation.~~

~~(iii) During delivery and installation of raking drains, care must be taken to ensure that the pipe and geotextile filter sheath are not damaged. Submit the method of installing the raking drains to the SO for approval prior to installation.~~

~~(iv) Before installation of drain pipes, check cleanliness of the drillholes. Whenever any obstruction encountered inside a drillhole during pipe insertion, withdraw the pipe and clear the obstruction before re-insertion. No jacking or hammering of pipes shall be carried out during the whole process of pipe insertion.~~

~~(h) Drilling for raking drains.~~

~~(i) Do not use drilling lubricants other than clean water or air for drilling holes for raking drains. Use casings to prevent collapse of the hole and to permit unobstructed insertion of the pipes and geotextile filter sheath.~~

~~(ii) Position the drillhole entry point within a tolerance of ± 75 mm. Deviation in alignment shall not exceed ± 2° to the vertical and horizontal alignment as specified by the SO. Deviation from straight shall not exceed 20 mm in any 3 m length of drillhole. Maintain a positive gradient throughout the complete length of the hole, and measure the inclination of holes by a method agreed by the SO.~~

~~(iii) Temporarily plug drillholes or protect them to prevent entry of deleterious material after drilling.~~

~~(i) Keep records of drillholes for raking drains on the Site, and submit a drillhole log for each drillhole to the SO before installation of the raking drain starts.~~

~~The drillhole log shall contain the following details:~~

~~(i) Drain reference number,~~

~~(ii) Location, inclination, bearings, diameter and length of hole,~~

~~(iii) Details of drilling progress,~~

~~(iv) Details of water seepage related to drilling progress, and~~

~~(v) Description of the materials encountered in the drillhole related to drilling progress.~~

PAINTING TO SPRAYED CONCRETE

Painting to sprayed concrete **26.70**

(a) Where ordered, paint the sprayed concrete with two coats of water-based paint for external use approved by the SO. The components of paint shall not be toxic or hazardous to health.

(b) Submit details of the paint products (e.g. specification and colour samples etc.) and method statement for the approval of SO prior to painting. The colour of the paint shall be "Antique" to **BS 5252F** and of the colour code as directed by the SO.

(c) Store paint and associated materials in a dry weatherproof store. Maintain the store in a cool, well ventilated condition. Tins of paint and associated materials shall be labelled to show their intended use, and shall be protected from exposure to conditions which may adversely affect the material. Store paint and associated materials in accordance with the manufacturers' recommendations, and do not use them after the recommended shelf life has been exceeded.

(d) Prepare the surface of sprayed concrete prior to applying the paint. The surface to be painted shall be clean, free of contaminants such as oils, grease, release agents, mortar splashes etc. All debris and loose materials shall be removed from the surface. Painting shall not be carried out in direct strong sunlight, hot windy conditions or in an environment with excessive dust.

(e) Mix paint in accordance with the manufacturer's instruction prior to application. Apply each coat of the paint to the surface using an airless spray at 12 m^2/L or equivalent to obtain a uniform finish or as recommended by the manufacturer. Allow sufficient time gap between the application of the first and second coat of paint as recommended by the manufacturer. Protect each coat of paint from rain for the first 24 hr after application.

SOIL-CEMENT FILL

Soil-cement **26.71**

(a) Soil-cement shall consist of Portland Cement (PC), sand and inorganic soil in the proportions 1:3:12 by mass unless otherwise stated. The mix proportion of soil-cement is 1:3:40 by mass when it is applied to the top layer (maximum 300 mm thick) or other areas as directed or agreed by the SO.

(b) PC shall comply with Clause 6.27.

(c) Sand shall be natural sand or crushed natural stone complying with **BS 1200:2019**.

(d) Inorganic soil shall be free from organic matter and shall contain not more than 30% of soil particles passing a 63 μm BS test sieve.

SUB-SOIL DRAINAGE SYSTEM

Geotextile Filter	**26.75***	(a)	All filter fabric shall comply with retention and permeability criteria specified in the Table 11 of GEO Publication No. 1/93 – Review of Granular and Geotextile filters
Micro-fine Cement Grout	**26.76***	(a)	Specific surface area of micro-fine cement shall not be less than 6000cm^2/g in compliance with SD EN 196-6
		(b)	D_{50} Particle size distribution characteristic of micro-fine cement shall not be greater than 10 μm
		(c)	Cementitious constituent in micro-fine cement grout shall comply with BS EN 197-1. Admixtures can be used under manufacturer's guidance subject to acceptance of *Project Manager*;
		(d)	Bleeding of grout shall comply with GS-B Clause 26.47 or otherwise agreed by the *Project Manager*.
		(e)	Water for grout shall be clean fresh water having a temperature not exceeding 30oC or less than 5^{o}C;
		(f)	Cement grout shall have a minimum cube strength of 30MPa at 28 days;
		(g)	The maximum total chloride content, expressed as a percentage relationship between the chloride ion and the cementitious content by mass in the grout shall be 0.1%;
		(h)	Any accepted admixtures shall be chloride-free and comply with BS EN 934;
		(i)	The flow cone efflux time of grout shall not be less than 15 seconds.
Sub-soil Drainage Pipe	**26.77***	(a)	Sub-soil drainage pipes shall be perforated uPVC pipe, the perforation of the drainage pipes and fittings shall comply with BS 4962;
		(b)	The perforation shall cover 5% of the surface area per meter area of the pipe. The perforations or slots shall be cleanly cut and shall be uniformly spaced along the length and circumference of the pipe
Rodding Eyes	**26.78***		Rodding eyes shall be cast iron rodding eye with recessed cover comply with BS 437
Drainage Layer	**26.79***		The size of drainage layer shall be fine gravel with maximum nominal size of 10mm. It shall be clean, hard, durable and well graded as stipulated in Geoguide 3 – Guide to Soil and Rock Descriptions
Galvanized Sediment Pan in Junction Pit	**26.80***		All coating thickness of galvanize shall comply with BS EN ISO 1461 for sediment pan in junction pit
Pressure Relief Wells	**26.81***	(a)	Pressure relief wells shall be perforated un uPVC pipe wrapped in filter fabric and covered with an impermeable fabric
		(b)	The perforation of the uPVC pipe shall cover 10% of the surface area per meter area of the pipe. The perforations or slots shall be cleanly cut, uniformly spaced along the length and circumference of the pipe, and to be wrapped with two layer of nylon mesh. The perforation of the uPVC pipes shall comply with BS 4962
Permanent Recharge Wells	**26.82***	(a)	Permanent recharge wells shall be perforated uPVC pipe wrapped in filter fabric
		(b)	The perforation of the uPVC pipe shall cover 6% of the surface area per

			meter area of the pipe. The perforations or slots shall be cleanly cut, uniformly spaced along the length and circumference of the pipe, and to be wrapped with two layer of nylon mesh. The perforation of the uPVC pipes shall comply with BS 4962
Permanent Piezometers	**26.83***		Piezometers shall measure groundwater level at minimum frequency of 30 minutes in automatic manner, and automatically record the measured groundwater level with the respective time and date of the measurement. The precision of the groundwater level measurement shall be 0.01m or better. Communication interface to transfer the recorded data via both wireless network and data transmission cable to Central Control and Monitoring System (CCMS) shall be included
Flowmeters	**26.84***		Flowmeters shall measure water flow rate at minimum frequency of 30 minutes in automatic manner, and automatically record measured water flow rate with the respective time and date of the measurement. The precision of the water flow rate measurement shall be 0.1 m3/hr or better. Communication interface to transfer the recorded data via both wireless network and data transmission cable to Central Control and Monitoring System (CCMS) shall be included
Submersible Pumps	**26.85***	(a)	The submersible pumps shall be of vertical centrifugal design suitable for dry sump or wet sump installation in accordance to the Section B3.3 of GS-DI;
		(b)	Each pump shall be constructed with double mechanical shaft seal and close-coupled to submersible electric motor in accordance to the Section B3.3. of GS-DI
		(c)	The submersible pumps should operate automatically under level control with an alarm to alert the operator when extra low level or high water level is being exceeded in accordance to the Section B3.3 of GS-DI;
Portable Pumps	**26.86***		The portable pumps shall operate automatically with minimum operation water level not greater than 130mm with essential power supply

BTRi PRODUCT SPECIFICATION FOR BUILDING

SECTION 27

MODULAR INTEGRATED CONSTRUCTION

SECTION 27
MODULAR INTEGRATED CONSTRUCTION

PRODUCTS AND WORKMANSHIP

General **27.12**

(a) Unless otherwise approved by the SO, the standards of materials and workmanship including all related testing requirements that are currently specified in other Sections of the General Specification shall be complied with.

(b) The structural system of the proposed MiC can be in the form of concrete, steel or hybrid concrete/steel system to suit the main building structure design.

(c) If steel material is used for forming part of the module, the steel section shall be galvanized in accordance with Section 15 with suitable provision on fire protection in accordance with statutory requirements.

(d) In general, all structural concrete works shall comply with Sections 6 and 7, and all structural steelwork shall comply with Section 15.

(e) At concrete, all fixing including bolts shall be cast-in. Post installation by drill-in anchor bolts is not permitted unless approved by the SO.

(f) All fixings cast in concrete shall either be made of stainless steel, hot-dip galvanized rolled steel or hot dip galvanized cold formed steel.

(g) Requirements of grout material for structural joints shall refer to Appendix 1.

QUALITY CONTROL AND SUPERVISION

Quality assurance scheme **27.14**

(a) Modules shall be fabricated by a factory with ISO 9000 or equivalent quality assurance certification. The Quality Assurance Scheme of the MiC prefabrication factory shall cover the items as stipulated in the quality control requirements of **PNAP ADV-36** issued by the Buildings Department.

~~(b) The Contractor shall submit the Quality Assurance Scheme to the SO for approval at least 14 days before commencement of the production work in the prefabrication factory. The MiC Designers shall provide a written confirmation that the submitted Quality Assurance Scheme has adequate provisions in ensuring the quality of production complying with the contract requirements and the accepted plans.~~

(c) The requirements and standards for quality control of the MiMEP shall refer to the **General Specification for Building Services Installation in Government Buildings of the HKSAR**.

Quality traceability system **27.15**

The MiC prefabrication factory shall establish and incorporate an information management system and code identification system. Radio frequency identification (RFID) technology shall be adopted for quality traceability of elements / modules to record the conformity of materials used, the manufacturing process, the logistics in delivery and the installation details.