

General Specification for Building 2017 Edition

The 2017 edition of the General Specification for Building has incorporated updates and revisions to the 2012 edition (incorporating Corrigendum No. GS 2012-02). Principle amendments and additions include a general review of the technical requirements, updating the international standards (such as ASTM, BS and BS EN etc.) as well as incorporation of further green specifications to be in line with the Government's green procurement policy. Please refer to the summary of major changes for details.

The updating of specification is a continuous process. The electronic version of this 2017 Edition of the General Specification for Building will be kept up-to-date and may be viewed on the ArchSD Internet homepage.

In view of the revisions and new additions, there will be an introductory period of about 3 months in preparation for full implementation of this 2017 edition as contract document starting from 1 October 2017.

In summary:

- For tenders to be invited on or after 1 October 2017, this 2017 edition shall be used.
- Existing contracts (including contracts using previous editions tendered before 1 October 2017) will not be affected.

ARCHITECTURAL SERVICES DEPARTMENT

GENERAL SPECIFICATION FOR BUILDING

2017 EDITION

The follow clauses and indexes are amended in the above edition of General Specification for Building.

Amendments to Section 1

Abbreviations	1.02	Abbreviations used shall have the following meanings: 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.
Proprietary brand name products or materials	1.09	The phrase “or alternative products or materials having equivalent functions or performance” shall be deemed to be included wherever products or materials are specified by proprietary brand names. Alternative products or materials of different brands or manufacture having equivalent functions or performance may substitute for the specified proprietary brand name products or materials if prior approval from the SO has been obtained. If the Contractor intends to use the intellectual property rights of another party in performing his obligations under the Contract, appropriate licences shall be obtained from the relevant rights owners.
Equivalent standards and imperial sizes	1.12	<p>When products or materials to the appropriate standards are not available, products or materials conforming with equivalent standards (or performance) shall be acceptable subject to approval.</p> <p>When a material is available in metric size, an imperial size equivalent shall not be acceptable.</p> <p>If a material is unobtainable in metric size, a material of the nearest equivalent imperial size which will fully meet the specification may be substituted if prior approval has been obtained, but the rates will not be changed from those submitted for the materials specified.</p>
Trees and shrubs	1.20	<p>Provide a record of existing trees, if any, within and in close vicinity (within 2000 mm) of the site boundary and works areas. (A plant is considered as a tree if its trunk diameter measures 95 mm or more at a height of 1300 mm above the ground level. (Guidance on measurement of tree diameter is given in Agriculture, Fisheries and Conservation Department’s Nature Conservation Practice Note No.2)) Photographic record and location plan for individual tree together with the Tree Schedule shall be submitted within 28 days after commencement of the Works or nomination by the SO. The Tree Schedule shall show the following particulars:</p> <p>(a) A number identity for each tree, also marked on each photograph;</p> <p>(b) The species (scientific names and Chinese common names);</p>

- (c) Trunk diameter (at 1300mm above the ground level);
- (d) Tree crown spread;
- (e) Overall height;
- (e) Condition of the tree;
- (g) Existing ground level at the root collar.

Protect and preserve all existing trees and shrubs on Site. No physical disturbance including transplanting/felling/pruning of any existing tree shall be permitted without prior written consent of the SO and the statutory approval.

Take precaution and provide all necessary on-site protection works/measures (including tree surgery works if so required) for individual existing tree, if any, within or in close vicinity (within 2000 mm) of the site boundary and/or works area throughout the Contract period.

Temporary fencing, if necessary shall be provided to prevent the encroachment of equipment or materials and contamination of the surrounding ground by oil or other deleterious substances. Do not bank spoil, vegetable soil or other materials within the drip-line zone of individual trees. If it is necessary to trim or cut back trees and shrubs, it must be done under the direction and supervision of the SO in strict compliance with Clauses 2.37 to 2.41 and Section 25 of the GS.

Make allowance in method of operation and vehicular access for tree preservation during the period of Works.

Submissions

1.39.3

- (i) The Contractor shall submit for the consent of the SO the following information in accordance with the CPFBS and CPFMS and Guidelines on the Design and Construction of Bamboo Scaffolds, issued by the Buildings Department, taking into account site and project conditions 10 days prior to commencing the erection, alteration or dismantling of the Scaffold System:
 - (a) The material specifications, test certificates, place of the origin, and instructions and procedures supplied by the manufacturers of the metal Scaffold System;
 - (b) The intended or current use of the Scaffold System and a method statement for the erection, alteration or dismantling of the same. Working drawings for the Scaffold System as per Clause 1.39.4 of this Section shall be submitted with the method statement;
 - (c) For any portion of the Scaffold System which cantilevers up from the top floor under construction, the method statement shall include adequate tie and strut arrangement for the cantilevered portion;
 - (d) The names, “substantial training” and “practical experience” of the “competent person”, the “trained workmen” and the “professional engineer” as referred to in CPFBS and CPFMS.
- (ii) The consent of the SO shall not relieve the Contractor of any duty or responsibility under the Contract.

Construction**1.39.5**

- (i) The Scaffold System shall be constructed and maintained in accordance with the following criteria:
 - (a) Provide firm and adequate supports to the Scaffold System at appropriate locations. If steel brackets are used as scaffold supports, their vertical spacing shall not exceed 15 m;
 - (b) Provide firm and adequate ties and struts for fastening the Scaffold System securely onto the structure or building. All temporary ties, fixing bolts and the like shall not be allowed to remain within the specified concrete cover and shall be cut back more than 40 mm (concrete cover for external elements) from the surface of structural concrete;
 - (c) Provide firm and adequate longitudinal, transverse and diagonal bracings to ensure the stability of the Scaffold System;
 - (d) Keep the space or clearance between working platforms and the structure or building as small as possible but it shall not exceed 300 mm wide;
 - (e) Where scaffolding is provided for structure or building exceeding 15 m in height, provide a protective canopy of nominal width 3600 mm at a maximum height of 6 m above ground along the edges of the structure or building at locations as directed by the SO;
 - (f) Where scaffolding is provided for structure or building which is under 30 m in height or is set back from the site boundary such that an inclined projection plane from the top outer edge of the structure or building at 10 degree from the vertical does not go beyond the site boundary at ground level, provide safety nets comprising nylon mesh of minimum 15 core threads with grids not more than 12 mm or of similar approved type covering the entire face of the structure or building. The safety nets shall be tautly fixed with minimum lap of 450 mm in any direction to the outer face of the scaffold;
 - (g) Where scaffolding is provided for structure or building except those specified in sub-clause (f) of this Clause, provide safety nets consisting of two layers in accordance with Buildings Department Practice Note **APP-102**;
 - (h) Use fire retardant material for safety nets;
 - (i) Provide a sloping catch-fan at not more than 15 m vertical intervals to give a minimum horizontal projection coverage of 1500 mm. The sloping catch-fan shall consist of timber boarding covered by a layer of galvanised metal sheeting, both of adequate thickness to capture and retain falling debris;
 - (j) Provide access/egress to and from the walkway at appropriate locations;
 - (k) Ensure that the sloping catch-fans and safety nets remain in place until all works are completed;
 - (l) Ensure that the Scaffold System will not be overloaded at any time. The Scaffold System including the sloping catch-fans, safety nets, walkways, protective canopies and the like shall be

kept clear of debris; and

(m) When plastic sheet is used to cover the Scaffold System, the Scaffold System shall be reinforced to withstand strong winds. Flame retardant sheeting shall be used at locations as specified by the SO. Obstruction of natural ventilation and lighting by sheeting should be avoided as far as possible.

(ii) During any inspection of the works, if the SO is of the opinion that part or whole of the Scaffold System is unstable, insufficient or requires modification in the interests of safety, the SO may, by notice in writing require the Contractor to modify the Scaffold System and the Contractor shall comply within a reasonable time.

(iii) On completion of the Works, the Contractor shall clean and make good the structure or building disturbed or damaged by the Scaffold System.

Technical requirements for safety in bamboo scaffolding

1.39.7

(i) When bamboo scaffolding is used for the Scaffold System, the Contractor's attention is drawn to Section 5 of CPFBSS.

(ii) Unless otherwise approved by the SO, all bamboo scaffolding shall be in accordance with the following drawings:

(a) For a structure or building not exceeding 15 m in height, the Scaffold System shall be in accordance with Drawing No. SCAFFOLD/3 at Annex A.

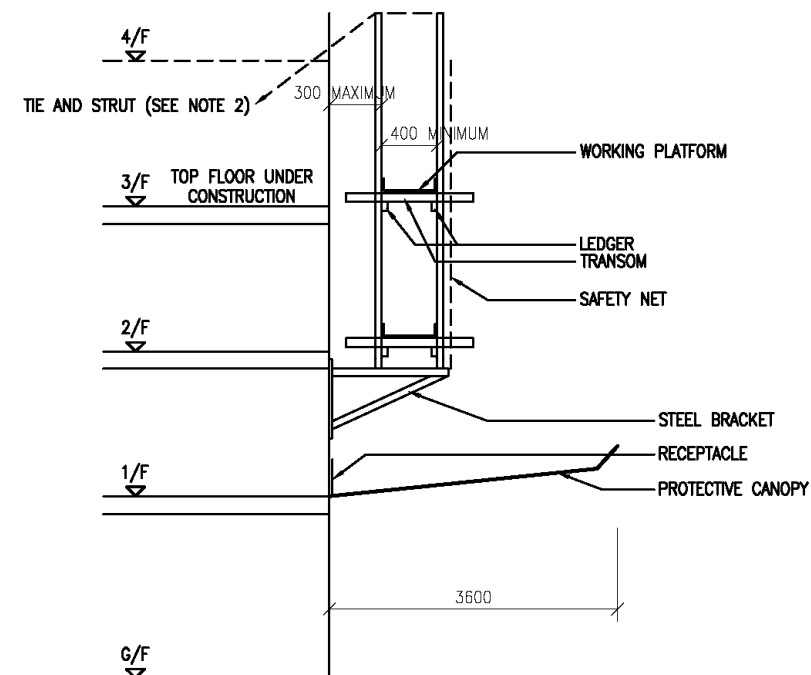
(b) For a structure or building exceeding 15 m in height, the Scaffold System shall be in accordance with Drawing No. SCAFFOLD/1 and SCAFFOLD/2 at Annex A.

(iii) Walkways shall be constructed as follows:

(a) 400 mm (minimum) wide continuous walkway formed by 200 mm (minimum) x 25 mm thick close timber boarding as referred in Figure 2 of CPFBSS, and

(b) 25 mm thick toe-boards 200 mm (minimum) high at each side of walkways from which a person or any object may fall more than a height of 2 m.

(iv) No bamboo scaffolding shall be stood for use over 24 months in a construction site. All the overdue bamboo scaffolding deemed by SO shall be dismantled and removed off site. Erect a new bamboo scaffolding if deemed necessary.




Stage 1

1. Erect protective canopy at 1st floor level.
 2. Fix steel brackets as scaffold support at 2nd floor.
 3. Erect outer and inner scaffold layers one floor above the top floor under construction.
 4. Fix the safety nets to outer scaffold layer up to 2m above the top floor level under construction.
 5. Provide working platform up to the top floor level under construction.
- No person is allowed to carry out any work on the scaffold if the working platform is not provided.

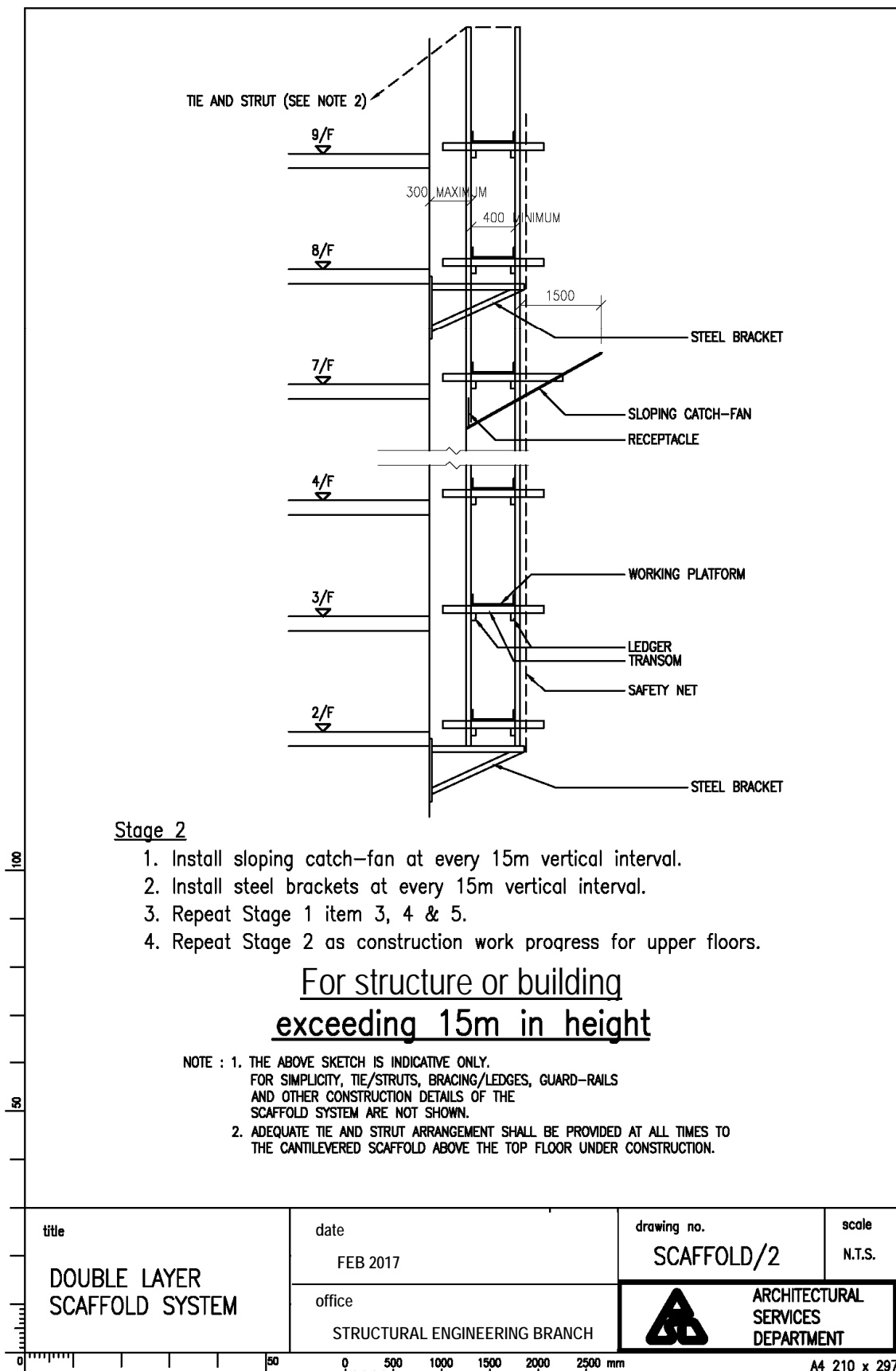
For structure or building exceeding 15m in height

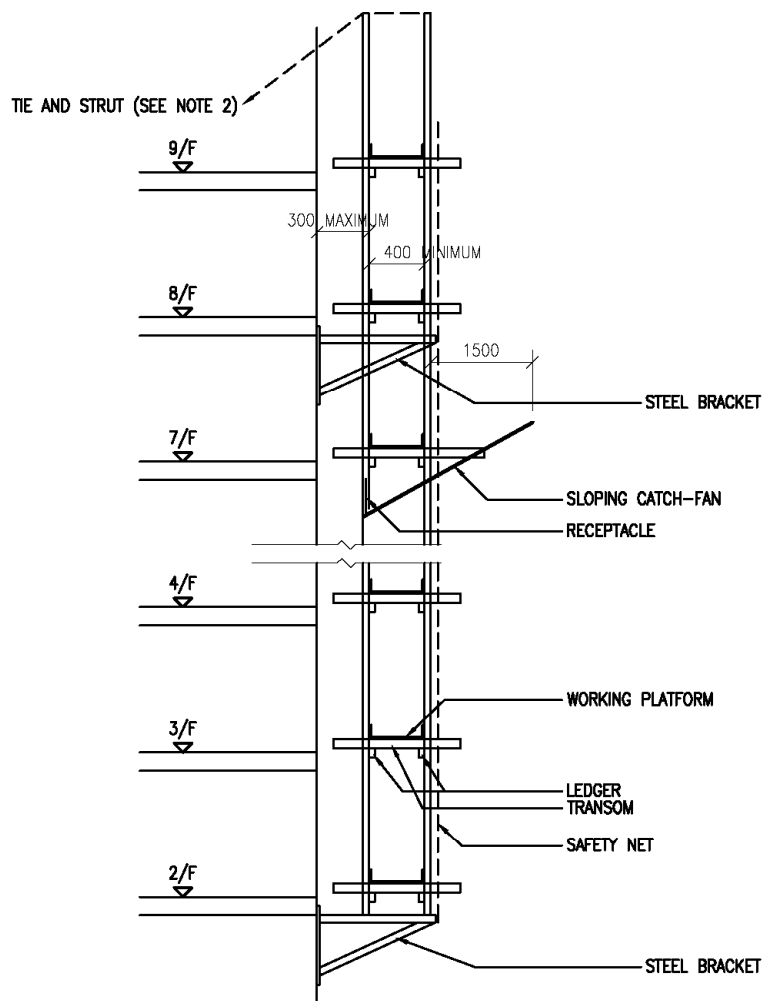
- NOTE : 1. THE ABOVE SKETCH IS INDICATIVE ONLY.
FOR SIMPLICITY, TIE/STRUTS, BRACING/LEDGES, GUARD-RAILS
AND OTHER CONSTRUCTION DETAILS OF THE
SCAFFOLD SYSTEM ARE NOT SHOWN.
2. ADEQUATE TIE AND STRUT ARRANGEMENT SHALL BE PROVIDED AT ALL TIMES TO
THE CANTILEVERED SCAFFOLD ABOVE THE TOP FLOOR UNDER CONSTRUCTION.

title	date FEB 2017	drawing no. SCAFFOLD/1	scale N.T.S.
DOUBLE LAYER SCAFFOLD SYSTEM	office STRUCTURAL ENGINEERING BRANCH	 ARCHITECTURAL SERVICES DEPARTMENT	

0 500 1000 1500 2000 2500 mm

A4 210 x 297






Stage 2

1. Install sloping catch-fan at every 15m vertical interval.
2. Install steel brackets at every 15m vertical interval.
3. Repeat Stage 1 item 3, 4 & 5.
4. Repeat Stage 2 as construction work progress for upper floors.

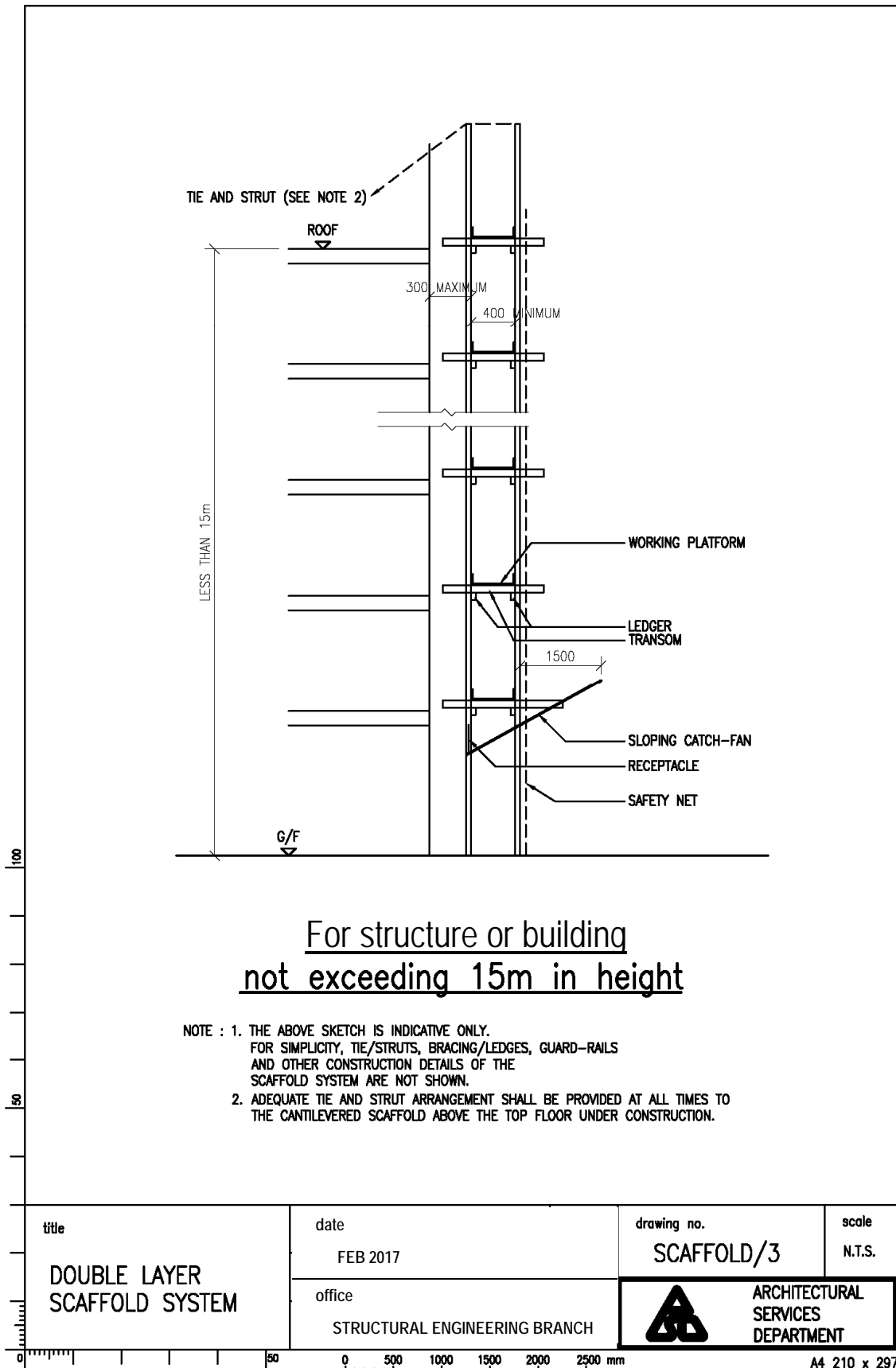
For structure or building
exceeding 15m in height

- NOTE : 1. THE ABOVE SKETCH IS INDICATIVE ONLY.
FOR SIMPLICITY, TIE/STRUTS, BRACING/LEDGES, GUARD-RAILS
AND OTHER CONSTRUCTION DETAILS OF THE
SCAFFOLD SYSTEM ARE NOT SHOWN.
2. ADEQUATE TIE AND STRUT ARRANGEMENT SHALL BE PROVIDED AT ALL TIMES TO
THE CANTILEVERED SCAFFOLD ABOVE THE TOP FLOOR UNDER CONSTRUCTION.

title	date	drawing no.	scale
DOUBLE LAYER SCAFFOLD SYSTEM	FEB 2017	SCAFFOLD/2	N.T.S.
	office	 ARCHITECTURAL SERVICES DEPARTMENT	
	STRUCTURAL ENGINEERING BRANCH		

0 500 1000 1500 2000 2500 mm

A4 210 x 297



Amendments to Section 2

Regulations, Ordinances, Codes of Practice & Practice Notes	2.01	<p>Comply with all relevant legislation, Codes of Practice and Practice Notes. Particular attention is drawn to the following:</p> <ul style="list-style-type: none">(i) Code of Practice for Demolition of Buildings issued by Buildings Department.(ii) Code of Practice for Site Supervision and Technical Memorandum for Supervision Plans issued by Buildings Department.(iii) Guidelines for Selective Demolition and On Site Sorting issued by Civil Engineering and Development Department.(iv) Building (Demolition Works) Regulations.(v) Building (Administration) Regulations.(vi) Construction Sites (Safety) Regulations.(vii) Noise Control Ordinance.(viii) Air Pollution Control Ordinance.(ix) Water Pollution Control Ordinance.(x) Factories and Industrial Undertakings Ordinance.(xi) Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations.(xii) Factories and Industrial Undertakings (Noise at Work) Regulations.(xiii) Factories and Industrial Undertakings (Safety Officers and Safety Supervisors) Regulations.(xiv) Air Pollution Control (Construction Dust) Regulation.(xv) Noise Control (Construction Work) Regulation.(xvi) The prevailing Buildings Department Practice Notes for Authorized Persons and Registered Structural Engineers.(xvii) The prevailing Buildings Department Practice Notes for Registered Contractors.
Registered Structural Engineer	2.03	<p>The Contractor shall appoint a Registered Structural Engineer (RSE) registered under the Buildings Ordinance for the preparation and endorsement of the method statements, with drawings and design calculations, Supervision Plan for the Contractor's Stream and any other submissions as required by SO. The duties and roles of the RSE should include but not limited to:</p> <ul style="list-style-type: none">(i) Take up the full design responsibility for method statements and all related drawings and calculations.(ii) Assume the role of Authorized Signatory's Representative in the Contractor's Stream under Supervision Plan.

- (iii) Check that assumptions made in the design of temporary works and method statements are validated on Site.
- (iv) Prepare a risk assessment report with the Safety Officer including an inspection schedule for all staff such as RSE, site engineer, Safety Officer, site agent, site supervisor/foreman on all critical activities in demolition works.
- (v) Pay such periodical supervision and make such inspections as may be necessary for proper control of the works and submit reports after each visit to certify the work is safe.
- (vi) Carry out inspections on other activities which, in his/her professional judgment, are critical and require close supervision.
- (vii) Should there be any formation and/or alteration to any slopes, retaining walls and other geotechnical features as a result of the demolition works in the vicinity of the work sites which require geotechnical submissions under current statutory requirements, the RSE shall be responsible to arrange a Registered Geotechnical Engineer (RGE) for all necessary geotechnical submissions to Geotechnical Engineering Office (GEO) as stipulated in DEVB Technical Circular and other relevant authorities for comments and approval prior to demolition of any structure in the vicinity of the affected slopes, retaining walls and other geotechnical features. All geotechnical submissions shall be prepared by the RGE who shall be under direct supervision of the RSE. The RGE shall also be required to update the slope registrations and Maintenance Manuals to all affected slopes, retaining walls and other geotechnical features with GEO where necessary. The RSE shall ensure that all geotechnical submissions and site supervisions are made in accordance with all current statutory requirements of GEO and are acceptable to the relevant checking divisions of GEO.
- (viii) Change of the RSE shall not be permitted without prior written consent of the SO. In case of change of RSE, the new RSE shall review and resubmit the method statements prepared by the former RSE and assume the role of Authorized Signatory's Representative in the Contractor's Stream under Supervision Plan.

Submission of Documents 2.04

Submission of documents for SO approval shall be two months before commencement of demolition works or other specified period. The documents shall include, inter alia, the following:

- (i) Demolition Plans and Stability Report including calculation, and Method Statements.
- (ii) Project Safety Plan and the associated Risk Assessment Report.
- (iii) Supervision Plan.
- (iv) Environmental Management Plan.
- (v) Details of hoardings, covered walkways, catch platforms, catchfans and all necessary precautionary measures in accordance with the Code of Practice for Demolition of Buildings issued by the Buildings Department.
- (vi) Mechanical plant & equipment list.

- (vii) Details of supervisory staff.

All the above plans and reports shall be prepared in accordance with the requirements of the Code of Practice for Demolition of Buildings. Items (i) to (v) shall be prepared and certified by the RSE.

Pay particular attention to detailed proposals for the demolition of the specific items and critical areas that may impact on the general safety of the public and on site personnel, including but not limited to:

- (i) Cantilevered canopies and balconies.
- (ii) External wall, parapet and features.
- (iii) Scaffolding systems with more than 1.5m projection.
- (iv) Any other structure as stated in the drawings or directed by SO.

**Demolition Plan
and Method
Statement** **2.05**

Prepare a Demolition Plan and Stability Report including calculation in accordance with the requirements of the Buildings Ordinance, Building (Administration) Regulations, Code of Practice for Demolition of Buildings and the relevant Practice Notes issued by the Buildings Department, and shall include a comprehensive Method Statement prepared and certified by the RSE. The comprehensive Method Statement of the demolition work shall include but not limited to the following details:

- (i) A scaled plan showing the locations of the structures to be demolished and their distances to the adjacent buildings, structures, streets and significant street furniture. The plan should also show the location of the site video cameras as stipulated in item 2.11. The plan should be fully dimensioned with levels and provide sections where appropriate. If possible, site photographs should be included as much as possible.
- (ii) An appraisal of the structures to be demolished including an assessment on the structural condition of the part of the structures that are relevant to the demolition works, site condition and adjacent properties. Any potential hazard that may be associated with the proposed demolition works should be included.
- (iii) A description of the proposed methods used to demolish the different parts of the structure. This should include descriptions of the equipment used, the schedule, sequence and proposed procedures for the demolition. Detailed instructions for demolishing special features and critical areas that may affect the safety of the public and on-site personnel should be included. Specific precautionary steps for identifying these features should also be included. The use of graphics could be particularly useful to convey the message.
- (iv) A method statement includes specification and details for precautionary measures, which are essential to safety. The type of precautionary features should meet the requirement of the demolition method selected and the site conditions. These features should include scaffolds, catch platform, temporary supporting systems to the part of the structure to be demolished and bracing for weakened structural elements.
- (v) A proposed plan for conveyance of debris, on-site management and off-site transportation of the debris. Anticipated traffic

condition should also be discussed to allow better planning for off-site transportation. On-site storage of debris shall be specified.

- (vi) A method statement includes detailed plan for removal and disposal of on-site hazardous materials, if any, and disposal in compliance with the environmental protection regulations.
- (vii) Access route for handling emergency situations, such as accident should be provided.
- (viii) Inspection and maintenance frequency for the precautionary measures and on site equipment should be included.
- (ix) A method statement should also include the storage and handling of flammable materials that would be used in the demolition process.
- (x) A suggested scheme of on site supervision and technical support for ensuring all works are carried out safely.
- (xi) Means to reduce dust, noise and vibration impacts.
- (xii) Stability checking calculations for the building to be demolished, its supports, if any, the adjoining properties and the loading due to powered mechanical plants, or equipment.
- (xiii) Detailed design for temporary supporting systems to support machines working on the building and protection of any structure that may be affected by the demolition.
- (xiv) Periodic inspection schedule on adjacent structures that would potentially be affected by the demolition to evaluate their structural conditions.
- (xv) If the project required temporary closure of traffic, a traffic plan with detailed locations of the temporary traffic sign.

**Technically
Competent
Persons**

2.06

Employ such number of technically competent persons (TCP) for the demolition works as required. The TCP should have obtained the required qualification (a relevant certificate, diploma, degree or registered professional engineer) and experience in the structural, civil or building discipline and have at least the number of years of relevant site experience in accordance with the Technical Memorandum for Supervision Plans and Code of Practice for Site Supervision issued by the Buildings Department.

The TCP(s) shall prepare daily site supervision reports to be endorsed by the RSE.

Site Engineer

2.07

Employ a site engineer, who shall be a Registered Professional Engineer in the structural, civil or building discipline with at least 5 years relevant experience. Submit the particulars of the site engineer, including name, qualification and previous experience, to the SO for approval within 7 days after commencement of the contract.

The site engineer shall conduct full time site supervision, oversee the entire process of the demolition works and prepare site supervision reports at each of the following stages. Such report should be submitted to the SO after completion of each stage of demolition works and before the commencement of the next stage of demolition works. These stages shall include:

- (i) When all site preparation works, including hoardings, covered walkway, scaffolding, catch fans, protective wire netting, dust screens, catch platforms, safety barriers have been erected; and
- (ii) When all temporary works for demolition of a particular structure have been erected prior to actual demolition; and
- (iii) At any stages identified by the SO as critical stage from the Demolition Plan submitted by the Contractor.

**Plant and
Equipment
Operator**

2.09

Operator of powered mechanical plant or equipment used in demolition work shall be in compliance with Regulation 9(3) of the Building (Demolition Works) Regulations; and shall have at least 3 years experience in operating the particular plant or equipment; and shall have completed a training course in “Demolition of Building Course for Plant Operators” organized by the Construction Industry Council Training Academy and obtained the relevant certificate or other equivalent training and certificate issued by a recognized examining body; and operate under the immediate supervision of a TCP of the demolition works.

Submit the personal particulars, qualifications and experience of the operators of powered mechanical plant or equipment proposed to be used in the demolition works in accordance with Regulation 31 of the Building (Administration) Regulations, to the SO before the commencement of the demolition works. The Contractor shall notify the SO within 7 days of any change in the appointment of the operator and provide personal particulars, qualifications and experience of the new operator.

**Video Recording
System**

2.11

When specified, provide and maintain two color video cameras for each building with resolution not less than 1920 x 1080 and with appropriate view angle coverage, light sensitivity and automatic focus & aperture, TV monitors and video recording systems, and with all necessary accessories including the recording media for transmitting and recording, to capture the entire demolition process. The video recording systems and video records shall be kept in a secured place to be agreed with the SO. The video signals from the cameras shall also be real-time connected or transmitted to the site office of the SO and be viewed and inspected by the SO with a TV monitor, equipped with switching system to each camera. The video cameras shall be installed at strategic locations as directed by the SO and be securely protected so that the entire demolition process including the movement of debris and the overall sequence of demolition can be captured. The video records shall be kept for inspection for at least 14 days. Post sufficient notices at conspicuous positions to notify the affected persons including the workers, the staff and the general public about the purpose of video recording system in accordance with Data Protection Principles set out in the Personal Data (Privacy) Ordinance.

**Hydraulic
Concrete Crusher
and Concrete
Breaker**

2.18

Hydraulic Concrete Crusher shall be used for demolition of reinforced concrete structures unless otherwise approved by SO.

Unless specified otherwise, the use of percussive type of concrete breaker is allowed during part of the demolition process. Submit proposal on limiting the noise generation for SO's approval. Subject to EPD approval on noise permit, the time allowed for using any percussive type of concrete breaker shall be agreed by the SO.

Wrecking Ball

2.19

The use of swinging ball, drop ball and blasting shall not be permitted for demolition work.

Environmental Management Plan	2.22	<p>Environmental Management Plan shall, in conjunction with the Demolition Plan, provide all necessary details including but not limited to the following:</p> <ul style="list-style-type: none"> (i) Method of handling demolished building debris. (ii) Routing and movement of debris from each floor to on grade holding area prior to leaving the site. (iii) Means of transportation of debris off the site. (iv) Time and frequency of debris disposal off site. (v) Record scheme on the tonnage of each truck load, truck licence plate, driver's name, trip tickets and location of dump site. (vi) The site supervisory personnel responsible for the debris management system.
Building Services and Drainage System	2.27	<p>The Contractor shall appoint a Building Services Coordinator to liaise and coordinate decommissioning of existing building services installations. The Building Services Coordinator shall have a diploma or higher certificate in building services, electrical or mechanical engineering from a recognized tertiary in Hong Kong or equivalent and have at least 5 years experience in building services installations of which at least 2 years experience shall be in building services co-ordination.</p> <p>Ensure all existing water supplies, drainage and building services provisions of adjacent buildings and areas will not be affected.</p> <p>Report to the SO for directions upon discovery of any previously hidden or unidentified services/cables. Any unknown cables/pipes so discovered shall be carefully exposed by hand tools or as directed by the SO.</p> <p>Provide all temporary water supplies and drainage connections to any adjacent buildings affected prior to disconnecting the existing supplies in the buildings.</p> <p>Coordinate all utility companies and organizations such as power supply companies, telecommunications network services operators, town gas supply company, liquefied petroleum gas supply company and Water Supplies Department and other parties appointed by the SO to carry out disconnection, diversion, relocation or removal of their equipment and installations.</p>
Safety Protection	2.33	<p>Provide and erect necessary and sufficient safety protection such as scaffolding, catch fans, protective wire netting, dust screens, catch platforms, safety barriers, additional hoardings and covered walkways etc. for the safety and convenience of traffic, passers-by, users of adjacent premises, or workmen employed on the Works. All safety protection shall be erected prior to the commencement of the demolition operation and shall be maintained in good conditions until the completion of the demolition work. Regular inspection and clearance of debris shall be carried out.</p>
Clearing weeds generally	2.40	<p>When instructed by the SO, the Contractor shall identify any Mikania micrantha as well as any other unwanted plants specified as noxious weeds by the SO and remove these plants from the Site as part of the site clearance work. The Contractor shall comply with the requirements in Clause 25.14(b) when clearing these unwanted plants.</p>

Waste disposal **2.51** Asbestos-containing waste generated from the removal work shall be properly disposed of in accordance with the requirements of the "Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste" published by the Environmental Protection Department.

Notification shall be given to the Environmental Protection Department at least ten days before the scheduled disposal of asbestos waste and a duly stamped trip ticket shall be submitted to the SO for confirmation of disposal.

Water contaminated with asbestos shall be filtered first before being discharged into soil drains.

Regulations, Ordinances and Codes of Practice (Asbestos) **2.54** Comply with all relevant legislation and Codes of Practice in connection with asbestos removal works. Particular attention shall be drawn to the following:

- (i) Factories and Industrial Undertakings (Asbestos) Regulations.
- (ii) Air Pollution Control Ordinance.
- (iii) Air Pollution Control (Asbestos) (Administration) Regulations.
- (iv) Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste, Environmental Protection Department.
- (v) Code of Practice on Asbestos Work using Full Containment or Mini Containment Method, Environment Bureau.
- (vi) Code of Practice on Safe Handling of Low Risk Asbestos Containing Material, Environment Bureau.
- (vii) Code of Practice on Asbestos Work using Glove Bag Method, Environment Bureau.
- (viii) Code of Practice - Safety and Health at Work with Asbestos, Labour Department.
- (ix) The prevailing Codes of Practice on asbestos control issued by Environmental Bureau.

Amendments to Section 3

- Definitions** **3.01**
- (i) (a) "Top soil" is soil capable of supporting vegetative growth.
 - (b) "Inert construction and demolition material" shall mean rock, rubble, earth, soil, concrete, asphalt, brick, tile and masonry generated from construction and demolition works.
 - (ii) "Suitable material" shall consist of naturally occurring or processed material, or inert construction and demolition material, which at the time of deposition is capable of being compacted in accordance with the specified requirements to form stable areas of fill. The soluble sulphate content of the suitable material placed within 500 mm of concrete, cement bound material or cementitious material shall not exceed 1.9 grams of sulphate, expressed as SO₃, per litre. The total sulphate content, expressed as SO₃, of the suitable material placed within 500 mm of metal work shall not exceed 0.5% by mass.

The method of testing of the total sulphate content shall be in accordance with Geospec 3 - Model Specification for Soil Testing issued by the Geotechnical Engineering Office.

- (iii) "Unsuitable material" is material other than suitable material or containing any of the following:
 - (a) Material susceptible to volume change, including marine mud, soil with a liquid limit exceeding 65% or a plasticity index exceeding 35%, swelling clays and collapsible soils.
 - (b) Peat, vegetation, timber, organic, soluble or perishable material.
 - (c) Dangerous or toxic material or material susceptible to combustion.
 - (d) Metal, rubber, plastic or synthetic material.
- (iv) "Rock" is hard material which in the opinion of the SO can only be removed by the use of blasting, wedges or pneumatic drills and shall include individual boulders or other masses exceeding 0.20 m³ in size.
- (v)
 - (a) "Rock filling material" shall consist of pieces of concrete or hard and durable rock of which the maximum size shall not be greater than three times the minimum dimension of individual pieces and in the opinion of the SO not more than 30% by mass is discoloured or shows other evidence of decomposition. No individual pieces shall exceed 400 mm in size.
 - (b) "Recycled rock filling material" (Grade 200) shall be recycled rock or inert construction and demolition material which is hard and durable, and free from cracks, veins, and other evidence of decomposition.
- (vi) "Hardcore" shall comprise the following with no material exceeding 150 mm in size:
 - (a) Rock filling material.
 - (b) Broken stone, hard brick, concrete or other comparable hard, inert, approved material. The material shall be free from dust, rubbish or deleterious foreign matter.
- (vii) "General filling material" shall be "suitable material". It may contain up to 25% rock distributed evenly throughout the whole mass of the material. General filling material shall contain no material exceeding 200 mm in size.
- (viii) "Fine filling material" shall be "suitable material" capable of passing through a 75 mm BS sieve.
- (ix) "Special filling material" shall be "suitable material" capable of passing through a 75 mm BS sieve. The special filling material shall be sampled and tested according to Geospec 3. The special filling material shall have the following characteristics:

- (a) Liquid limit shall not exceed 45%.
- (b) Plasticity index shall not exceed 20%.
- (c) Coefficient of uniformity shall be greater than 50.
- (d) The percentage passing a 63 μm BS sieve shall be less than 45% by mass.
- (x) "Embankment", "filling area" or "area of fill" means an area on the Site other than a foreshore or sea-bed where the ground level shall be raised by filling in layers as part of the Works.
- (xi) "Trench excavation" means excavating from ground level not exceeding 5000 mm in width at surface.
- (xii) "Bulk excavation" means excavation in the open other than trench excavation.
- (xiii) Well-graded material shall consist of material that has a coefficient of uniformity exceeding 10.
- (xiv) Uniform-graded material shall consist of material that has a coefficient of uniformity of 10 or less.
- (xv) The coefficient of uniformity (C_u) shall be calculated as $C_u = D_{60}/D_{10}$ where D_{60} and D_{10} are the equivalent sieve sizes in millimetres, interpolated from the particle size distribution curve, through which 60% and 10% of the filling material would pass respectively.
- (xvi) The different types of filling material shall have the particle size distributions within the ranges stated in Table 3.1.

TABLE 3.1

Particle size distributions of filling material

Type of filling material	Percentage by mass passing					
	Size		BS test sieve			
	400 mm	200 mm	75 mm	20 mm	600 μm	63 μm
Fine filling material	-	-	100	-	-	-
General filling material	-	100	75-100	-	-	-
Special filling material	-	-	100	-	-	0-45
Recycled rock filling material (Grade 200)	-	100	20-75	0-50	-	-
Rock filling material	100	20-75	10-30	0-25	-	-

Note: The definitions of trench excavation and bulk excavation stated in sub-clauses (xi) and (xii) are for the purposes of the GS only and do not apply to the measurement of excavation in Bills of Quantities which are measured in accordance with the current edition of the Standard Method of Measurement of Building Works for use in Hong Kong.

Record survey	3.03	<p>Spot levels and contours shown on drawings are, unless otherwise stated, reduced to principal datum.</p> <p>Check the accuracy of site levels shown on drawings. Where levels are found to be inaccurate, notify the SO in writing before commencing excavation or earthwork. No claim in respect of inaccuracy of levels will be entertained after the relevant site levels have been altered by the Works.</p> <p>Where specified, make an oversite topographical survey by an approved independent firm included in the current List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Land, Engineering and Hydrographic Survey Services before any work is carried out under the Contract and again, after all excavation and filling work has been completed. If an independent firm is not employed, agree with the SO that plans or sections prepared from the above truly represent the original ground levels and the final levels required by the Contract and ensure that both parties sign the drawings. These endorsed drawings shall become the record surveys for the measurement of earthwork quantities.</p>
Temporary works for earthworks	3.04	<p>Design the temporary works associated with earthworks, including temporary slopes, stockpiles and drainage, such that the risk of failure is not more than that which would be adopted if the temporary works were to be permanent. Allowance may be made in the design of the temporary works for the shorter design life and for the risk to persons and property and the surface water and groundwater conditions which may occur during construction.</p> <p>The Contractor shall provide details to SO to demonstrate that the design of temporary works has been considered and incorporated measures, which minimise excavation of materials.</p>
Generally	3.08	<ul style="list-style-type: none"> (i) Adequate support shall be used to maintain excavations in a stable condition and to prevent settlement of structures or utilities due to excavation or dewatering. Construction plant or other vehicles shall not be operated or parked adjacent to excavations and earthworks materials or other materials shall not be placed adjacent to excavations unless this has been allowed for in the design of the temporary works for the support of the excavation. (ii) Keep excavation free of water in accordance with Clause 3.05. (iii) Neatly trim the face of excavation. (iv) Carry out excavation to the lines, levels, dimensions and slopes specified. (v) Carefully level the bottom of excavation and step or bench horizontally as specified. Remove any pockets of soft material or loose rock in the bottoms of pits and trenches and fill the resulting cavities and any large fissures with Grade 10 or higher grade concrete. Do not trim the side faces of excavations for at least 24 hours after placing any blinding concrete required by the Contract. (vi) Backfill in accordance with the GS and at no extra cost "over-excavated" areas where the Contractor's proposed method of excavation, if approved, involves excavation in excess of that specified in certain areas.

- (vii) Maintain excavated surfaces to be used for construction traffic at a level of 300 mm minimum above formation level unless in rock. Make good any damage to the surface arising from such use with material having the same characteristics as the material which has been damaged.
- (viii) Ensure that no construction traffic uses an area once trimming to final formation level has commenced, with the exception of plant necessary for such trimming, and ensure that no damage is caused to the surface by this plant.
- (ix) Make good, at no extra cost, surfaces which, after excavation, have deteriorated to a condition that makes compaction of backfilling impracticable, either by carrying out additional excavation and filling in accordance with this GS or, by waiting until the condition of the exposed material is, in the opinion of the SO, fit to receive the approved backfill.
- (x) Excavate in such a manner that suitable material is kept separate and store in temporary spoil heaps to the satisfaction of the SO, where required for use in the Works without contamination by unsuitable material or deterioration. Where, in the opinion of the SO, suitable material has become contaminated by unsuitable material or has deteriorated, this material shall be removed from Site and replaced with suitable imported material at the Contractor's expense.
- (xi) Take necessary precautions to prevent damage to existing drains and services encountered in and around the excavation. Should any damage occur, notify the SO and the relevant authorities concerned immediately and make good at no extra cost. Temporarily divert ditches, land drains or other waterways encountered in the excavation and subsequently reinstate at the Contractor's expense.
- (xii) Take necessary precautions to prevent damage to tops of piles during excavation.
- (xiii) Bottoms of excavation shall be approved before any new work is laid. Inform the SO when excavation is ready for inspection. Do not trim and blind the bottom of excavation without approval.

Tolerance for excavation

3.11

Excavation shall be within the tolerances stated in Table 3.2 of the specified design profile.

TABLE 3.2

Tolerances for excavation final surfaces.

Type of surface	Tolerance for excavation except in rock (mm)		Tolerance for excavation in rock (mm)	
	+	-	+	-
Formations for foundation and utilities	0	25	0	150
Formations for pavements	0	50	0	150
Note: A positive tolerance refers to under excavation and a negative tolerance refers to over excavation.				

In case of cut slopes, the tolerance shall not exceed 75 mm measured at right angles to the batter.

Filling**3.17**

- (i) Unless otherwise specified, filling material shall consist of general filling material obtained from excavation on Site, borrow areas or other approved sources.
- (ii) Provide for the SO's approval a method statement showing the sources of fill for each fill area, the construction plant to be used for placing filling material and the method of compaction.
- (iii) Commence filling works only when sufficient compaction plant is in operation at the place of deposition to ensure compliance with the requirements of Clauses 3.19 or 3.20.
- (iv) Filling material shall be deposited in layers of a thickness appropriate to the compaction method to be used. In deposition of filling material, ensure that a good bond is achieved between layers of fill, and unless otherwise directed by the SO, no material shall be placed on previously compacted layers unless the surface has been scarified or otherwise broken up and, if necessary, watered.
- (v) Blind the top surface of hardcore, recycled rock filling material and rock filling material with fine filling material.
- (vi) Cut benches or trenches as shown on the drawings and as directed by the SO where filling shall be formed on sloping ground and provide any necessary under-draining of the affected part of the Site.
- (vii) Keep the fill area free of water in accordance with Clause 3.05.

- (viii) Obtain approval from the SO before commencing filling and before any fill layer is covered.
 - (ix) Do not use "end tipping" in filling.
 - (x) Leave surfaces with no area that can retain water at the end of each day's work and, if necessary, cut ditches to achieve this.
 - (xi) Stop work when the state of the weather is such that, in the opinion of the SO, it will adversely affect the placing of compacted fill.
 - (xii) Adopt one of the following procedures when material placed and compacted, or awaiting compaction, reaches a condition which, in the opinion of the SO, does not comply with the GS or has been damaged either by weather or in any other way:
 - (a) Remove the material from Site, replacing it with equivalent suitable material.
 - (b) Remove the material to stockpile until it is in a suitable condition for reuse.
 - (c) Make good the material by mechanical or chemical means.
 - (d) Cease work on the material until it is in a suitable physical condition for reuse.
- Obtain approval from the SO before any of these options are adopted.
- Remove, and adopt option (a) or (b) above for any material not complying with the GS that has been overlaid by more recently placed material.
- (xiii) Make good to the satisfaction of the SO settlement in filling and backfilling and any consequential damage that may occur up to the end of the Maintenance Period.

Tolerance for filling

3.18

Filling shall be within the tolerances stated in Table 3.3 of the specified design profile.

TABLE 3.3
Tolerances for filling

	Tolerance (mm)	
	+	-
Formations for foundation and utilities	0	25
Formations for pavements	0	50
Fill platforms	0	50
Fill slopes	50	50
Note: A positive tolerance refers to excess filling material and a negative tolerance refers to insufficient filling material.		

**Compaction by
performance
specification**

3.19

- (i) Agree with the SO the thickness of each layer which shall be compatible with the particular filling material and the specific compaction plant to be used. Carry out carefully control tests to determine the optimum placing thickness for the particular filling material and the number of passes to achieve the required density with the specific compaction plant to be provided. No permanent fill shall be placed until such compaction procedure and control tests results have been agreed with the SO. Earth moving plant will not be accepted as compaction equipment under this clause. Spread material in layers of uniform thickness and compact as soon as practicable after deposition.
- (ii) Test the material to be compacted in accordance with Clause 3.21 to determine its maximum dry density and moisture content.
- (iii) Not used.
- (iv) Carry out in-situ field density tests to determine the relative compaction in accordance with Clause 3.21 after compaction with the following arrangement:
 - (a) Test each layer and obtain approval from the SO prior to placing of the next layer, or
 - (b) Subject to the approval from the SO, tests for each layer may be performed after filling material in not more than 2 layers above have been deposited and compacted. If the results of any tests at lower layers do not comply with the specified requirements for relative compaction, the soil layer and all the layers above shall be re-compacted and tested with additional tests for relative compaction. The number of additional tests shall refer to Table 3.6. Further deposition of filling shall not be allowed unless all the underlying soil layer(s) have satisfied all the test requirements. No claim in respect of re-compaction and additional tests of the soil layer due to non-compliance of the soil underneath will be entertained.
- (v) The relative compaction (RC) of filling material shall be determined in accordance with the following equation:
$$RC = IDD/MDD \times 100\%$$

where:

 - IDD is the in-situ dry density determined in accordance with Clause 3.21
 - MDD is the maximum dry density determined in accordance with Clause 3.21
- (vi) Unless otherwise specified filling material shall be compacted to obtain the following relative compaction (RC):
 - (a) Fill within the 1.5 metres thick top surface zone of the platforms and fill within the 2.5 metres thick top surface zone of the peripheral slopes measured at right angles to the batter - RC of at least 95%.

- (b) Interior of large fill platforms which do not or will not support structures - RC of at least 90%.
- (c) Interior of large fill platforms supporting structures - RC of at least 95%.
- (d) Fill immediately below road formation level - RC of at least 98% for a depth of 200 mm.
- (e) Backfill to foundation pits or underneath suspended ground slab - RC of at least 90% or as agreed by the SO.

Compaction by method specification **3.20**

Compaction by method specification shall only be adopted for rock filling material, hardcore or general filling material with a large portion of coarse material. Submit to the SO for approval a method statement covering particulars of the filling material, compaction layer thickness, specific compaction plant to be used, compaction procedure and the site control measures. Allow for control tests on the proposed method statement as required by the SO. Inspect and record compaction procedures and details carried out on site.

Carry out sieve analysis to determine the particle size distribution for each source of filling material. The number of tests required for each source of material shall be as stated in Table 3.5. If the results do not comply with the specified requirements, additional samples shall be provided from the same batch and additional tests shall be carried out. The number of additional samples shall be as stated in Table 3.5. If the results of the additional tests do not comply with the specified requirements, the material of the source shall not be allowed for compaction by method specification.

The size of samples of filling material other than rock filling material shall be in accordance with Geospec 3. Each sample of rock filling material of Grade size not exceeding 200 shall have a mass of at least 250 kg and each sample of rock filling material of Grade size exceeding 200 shall have a mass of at least 1000 kg.

- (i) Compaction of rock filling material or hardcore
 - (a) Spread and level each layer of rock filling material or hardcore and systematically compact by at least 12 passes of a towed vibratory roller with a minimum static load per 100 mm width of roller of 1.75 kN or a grid roller with a minimum load per 100 mm width of roller of 7.8 kN or other equivalent plant approved by the SO. Each layer of rock filling material for compaction shall not exceed 450 mm.
 - (b) The surface voids of each layer of rock filling material or hardcore shall be filled with fragments of rock before the next layer is deposited. The final surface of rock filling material or hardcore shall also be blinded with fine filling material.
- (ii) Compaction of general filling material with a large portion of coarse material

General filling material with a large portion of coarse material shall consist of material of which less than 90% passes a 20 mm BS test sieve. It shall be compacted to the following requirements:

- (a) Spread and level each layer of general filling material with a thickness not less than 1.5 times of the maximum size of the general filling material and not exceeding the maximum depth of compacted layer in accordance with Table 3.4. If there is a presence of over-sized coarse material in the filling material, the over-sized coarse material shall be removed or broken down to sizes acceptable to the SO. Each layer shall be systematically compacted by an approved vibratory roller with the stipulated minimum number of passes corresponding to the minimum static load per 100 mm width of the roller.
- (b) The number of passes of the roller shall only be counted when the roller is travelled on the material to be compacted at a speed of not more than 2 km per hour with full vibration. Plant with addition of external load to increase the static load of the vibratory roller shall be disregarded in counting the number of passes.

TABLE 3.4

Compaction requirement for general filling material with a large portion of coarse material

Static Load per 100 mm width roller	Well-graded material		Uniform-grade material	
(kN)	Maximum depth of compacted layer (mm)	Minimum no. of passes	Maximum depth of compacted layer (mm)	Minimum no. of passes
0.25 – 0.45			150	16
0.46 – 0.70			150	12
0.71 – 1.25	125	12	150	10
1.26 – 1.75	150	8	200	10
1.76 – 2.30	150	4	225	10
2.31 – 2.80	175	4	250	10
2.81 – 3.50	200	4	275	8
3.51 – 4.20	225	4	300	8
4.21 – 4.90	250	4	300	8

Test for determining the degree of compaction of compacted fill

3.21

Arrange for tests specified below to be carried out by the Public Works Laboratories (PWL).

- (i) Compaction tests shall be carried out on Site unless approved otherwise.
- (ii) Determine the maximum dry density and optimum moisture content in accordance with **Geospec 3**.

Test each soil type when first used and thereafter at the same time as every set of field density tests is carried out or whenever the SO may direct. Unless otherwise specified, the number of tests required shall be as stated in Table 3.5. Keep the records identifying the soil type and the location within the Works.

- (iii) Determine the in-situ field density and moisture content in accordance with Geospec 3 as directed by the SO to determine the relative compaction achieved.

Unless otherwise stated in the Contract, the number of tests required shall be as stated in Table 3.6. Keep records identifying the soil type and location in the Works and showing the following information for each series of tests:

- (a) Dry density of soil tested.
- (b) Moisture content.
- (c) Relative compaction achieved (%).
- (iv) Determine moisture content in accordance with moisture content tests under Geospec 3 by means of a drying oven.

TABLE 3.5
Number of samples for testing of optimum
moisture content and maximum dry density of filling material and
sieve analysis of the same source of filling material

Description	Size of batch	No. of samples per batch
Special filling material	0 - 3000 m ³	3
	more than 3000 m ³	1 for each 1000 m ³ or part thereof
Filling material other than special filling material	0 - 15000 m ³	3
	more than 15000 m ³	1 for each 5000 m ³ or part thereof
Note: A batch is any quantity of filling material which is of the same type and which has similar properties, as determined by the SO.		

TABLE 3.6

Number of samples for testing of moisture content
and relative compaction

Description	Size of area of fill in batch	No. of samples No. of tests per batch
Areas of fill in excavations for structures, pits and trenches and on formations	less than 100 m ²	3
	100 – 500 m ²	2 for each 100 m ² or part thereof
	more than 500 m ²	1 for each 100 m ² or part thereof
Areas of fill other than in excavations for structures, pits and trenches and on formations	less than 1 ha	4 for each 1000 m ² or part thereof
	1 - 10 ha	3 for each 1000 m ² or part thereof
	more than 10 ha	2 for each 1000 m ² or part thereof
<p>Note: For the purpose of testing moisture content and relative compaction, a batch is any quantity of filling material which is of the same type and which is deposited in a single layer in any one location of fill presented by the Contractor for testing on one occasion.</p> <p>Formation is that part of the earthworks final surface on which a pavement, structure or utility, is constructed, or on which the blinding or bedding for a pavement, structure or utility is placed.</p>		

Embankments 3.23

- (i) Form embankments of special filling material unless otherwise specified.
- (ii) Deposit and compact all earthwork material for filling as soon as practicable after excavation. Build up embankments evenly over the full width. Control and direct construction traffic during the construction of embankments uniformly over their full width. Form sloping faces of embankments and other fill areas by 1 m overfilling unless otherwise directed by the SO and cutting back to the desired profile. Make good damage to compacted layers caused by construction traffic.
- (iii) Compact embankments in accordance with Clauses 3.19 or 3.20.

- (iv) Adopt one of the following procedures at no extra cost when material deposited as fill subsequently reaches a condition such that it cannot be compacted in accordance with the GS.
 - (a) Make good by removing the material from the embankment to tip or elsewhere until it is in a suitable physical condition for reuse and replace it with suitable material.
 - (b) Make good the material by approved mechanical or chemical means to improve its stability.
 - (c) Cease work on the material until its physical condition is suitable such that it can be compacted in accordance with the GS.
- (v) Rock used in rock fill embankments shall, except for any specified external cover to slopes or near formation level, be of a size such that it can be deposited in horizontal layers each not exceeding 450 mm thick before compaction, extending over the full width of the embankment. Spread and level the material by a crawler tractor weighing not less than 15 tonnes and compact in accordance with Clause 3.20(i). Each layer shall consist of reasonably graded rock and all surface voids shall be filled with broken fragments before the next layer is placed. Blind the top surface and side slopes of embankments so formed with approved fine filling material to seal the surface. On side slopes and verges, such material may be topsoil as defined in Clause 3.01.
- (vi) Isolated boulders each within the range 0.015 m³ to 0.10 m³ in size may be incorporated in embankments not of rock fill at the discretion of the SO provided that the specified compaction requirements are met. Boulders exceeding 0.015 m³ shall be placed a minimum of 2 metres below formation level of carriageways or hard-shoulders.
- (vii) Form embankments equally on both sides of culverts or drain pipes and the like.
- (viii) Where surfaces of embankment are required for use by construction traffic, build up and maintain at minimum 300 mm above formation level the area between the extremities of carriageways, including any central reserve and hard shoulders before subsequently trimming to formation level. Make good surface damage at no extra cost. Ensure that no construction traffic uses an area once trimming to final formation level has commenced, with the exception of plant necessary for such trimming and ensure that no damage is caused to the surface by such plant.

Amendments to Section 4

Re-use steel sheet pile from other site 4.17

Re-use of steel sheet piles from other site is permissible if they are used as temporary works and their physical conditions are considered satisfactory by the SO.

For steel sheet piles re-used as temporary works with design prepared by the contractor that require checking and certification by independent checking engineer or structural design checker, mill certificate and testing

requirements of steel sheet piles may be exempted by the independent checking engineer or structural design checker who shall provide justifications to the SO for prior agreement.

For other steel sheet piles re-used as temporary works, steel sheet piles may be re-used without testing, subject to contractor's provision of adequate proof evidence, e.g. mill certificate or testing certificate of structural steel materials, etc., showing that the steel sheet piles are in compliance with the specification.

Amendments to Section 5

Generally

5.01

- (i) Piles shall be Contractor designed unless otherwise specified.
 - (ii) The approved types of piles that may be adopted by the Contractor unless otherwise specified are:
 - (a) Precast concrete piles.
 - (b) Precast prestressed tubular piles.
 - (c) Percussion cast in-situ concrete piles.
 - (d) Steel 'H' piles.
 - (e) Non-percussion cast in-situ concrete piles.
 - (f) Large diameter bored piles.
 - (g) Minipiles.
 - (h) Rock-socketed Steel H-piles (RSSHP).
 - (i) Barrette piles.
 - (j) Any other piling systems approved by the Development Bureau.
 - (iii) Support all loadings as specified with piles. Unless otherwise stated, all loads are acting at the geometric centres of columns and walls.
 - (iv) In addition to the loads given in the loading schedule, the weight of pile caps or backfill over the pile caps and the imposed load over the plan area of the pile caps, which shall be taken as 7.5 kN/m² unless specified otherwise, shall be included in the pile loading.
 - (v) Design piles for the most critical loading generally produced from the following combinations:
 - (a) Dead load + imposed load + adverse soil and water load.
 - (b) Dead load + imposed load + adverse soil and water load + wind load.
- NOTE: The allowable load capacity of piles in the load case with wind load may be increased to 1.25 times the appropriate values as given in Clause 5.04.
- (c) Minimum dead load + wind load + adverse soil + water load (uplift) due to the highest anticipated groundwater table.

- (vi) Piles shall not be positioned directly under any wall opening as indicated on the drawing.
- (vii) No piles or portions of pile caps outside the Site boundary shall be permitted.
- (viii) The use of tension piles shall not be permitted unless otherwise stated.
- (ix) Carry out piling work in accordance with **Code of Practice for Foundations** published by Buildings Department.
- (x) The piling work shall be executed by a Contractor on the List of Approved Suppliers of Materials and Specialist Contractors for Public Works - Land Piling.
- (xi) The following works specified in the Contract shall be carried out by an independent Ground Investigation Contractor from the List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Ground Investigation Field Work Category:
 - (a) site borings to pre-determine the piles founding levels in accordance with Clause 5.19;
 - (b) pre-drilling for determination of pile length or to establish bedrock level;
 - (c) core drilling;
 - (d) proof drilling;
 - (e) other works as instructed by the SO.

Design submission 5.02

- (i) Submit two copies of the following information:
 - (a) A full specification of the piles proposed. Piles of the same size and material shall be designed and constructed to the same allowable load capacities irrespective of the actual design load sustained by each pile. Should the Contractor design the pile by adopting a smaller allowable load capacity of pile, the adopted allowable load capacity shall be used for calculating the test load for the static loading test.
 - (b) A complete set of design calculations for the piles. The load to be taken by each pile during the life of the superstructure shall not exceed the allowable load capacity of the pile.
 - (c) A drawing showing the number, position and size of the piles, the estimated maximum and minimum gross lengths of the piles (i.e. distance from ground level to tip of piles) and the proposed pile cap layout.
 - (d) A method of installation including equipment to be used, sequence of operations, quality supervision and site control measures.
- (ii) Obtain the agreement of the SO in writing to the matters referred to in item (i) above before work commences. No piling works shall commence on site unless the design submissions are approved by the SO in writing.

- (iii) Submit as specified two copies of the following information certified by a Registered Structural Engineer when the Contractor is required to carry out design of pile caps and/or strap beams:
 - (a) Complete set of calculation on the design of pile caps and strap beams, in compliance with **Code of Practice for the Structural Use of Concrete** issued by the Buildings Department.
 - (b) Drawing showing the proposed pile cap layout and strap beams with levels, sizes and typical details. The drawing presentation shall comply with the Drafting Manual for Reinforced Concrete Structures for Architectural Services Department.
- (iv) Each load element (column or wall) shall be supported on individual pile cap. Combination of loads from individual elements supported by one large cap shall not be allowed unless otherwise noted.
- (v) If hydraulic hammer is used in the project, the following shall apply:
 - (a) In addition to those stated in Clause 5.02 (i) above, submit two copies each of the following:

Details of piling equipment to be used which shall include the model number, hammer weight, drop height, and theoretical energy output etc.
 - (b) Unless approved otherwise by the SO, Hiley Formula shall be used in assessing the allowable load capacity of the piles proposed.
 - (c) The efficiency of drop of the hydraulic hammer used in the Hiley Formula shall be taken as 90% unless a higher value can be verified in accordance with Clause 5.14 (iv).

Provision of drawings and calculations

5.03

- (i) Submit the following to the SO:
 - (a) One complete set of the agreed calculations referred to in Clause 5.02, and
 - (b) Three copies of the agreed drawings provided in accordance with Clause 5.02.
 - (c) One complete set of revised calculations and three copies of revised drawings pursuant to a variation order.

Record survey and drawings

- (ii) Arrange for a survey to enable preparation of the piling record plans to show the positions, cut-off levels, gross and nett lengths of the piles, and the record survey drawings to show the as-built works included in the Contract.

The survey shall be carried out jointly by the Contractor and an approved independent firm included in the current List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Land, Engineering and Hydrographic Survey Services employed by the Contractor at his own cost. These as-built piling record drawings shall be certified by both the Contractor and the independent firm.

Submit to the SO within 14 days after the completion of the piling works, two copies each of the following:

- piling record plan showing the position, cut-off level, gross and nett lengths of the piles.
- record survey drawings showing the as-built works included in the Contract.

(iii) For cases where construction of pile caps and strap beams are included in the contract, the independent firm shall also set out and mark on the surface of the pile caps or ground/strap beams the outline of all columns and walls for checking by the SO.

Allowable load capacity of piles 5.04

- (i) The allowable load capacity of piles for loads along the vertical axis must be such that the average compressive stress imposed by this loading does not exceed 25% (20% only for precast concrete piles) of the design grade strength of the concrete or 7.5 MPa whichever is smaller, of the nominal cross-sectional area of precast concrete piles or the cross-sectional area of the tube or auger for cast in-situ concrete piles. The effect of reinforcement shall not be included in the calculation of the allowable load capacity.
- (ii) The allowable load capacity of precast prestressed tubular piles for loads along the vertical axis must be such that the average compressive stress imposed by this loading does not exceed 25% of the design grade strength of the concrete less the prestress after losses.
- (iii) The allowable load capacity of steel 'H' piles (for a driving resistance of 2) for loads along the vertical axis must be such that the average compressive stress imposed by this loading does not exceed 30% of the yield stress appropriate to the type of steel and thickness given in Table 5.1 below:

TABLE 5.1

Minimum yield stress with thickness

Steel Specification	Up to and including 16 mm	Over 16 mm Up to and including 40 mm
BS EN 10025 -Grade S275	275 MPa	265 MPa
BS EN 10025 -Grade S355JR	355 MPa	345 MPa
BS EN 10025 -Grade S450J0	450 MPa	430 MPa

Unless specified otherwise by the SO, no corrosion protection to the steel 'H' pile is required. However, when the steel 'H' pile is subjected to combined axial and bending under working load, the combined extreme fibre stress shall not exceed 0.33 fy, where fy is the minimum yield stress of the steel 'H' pile. When the calculation of stress is based on loadings including wind load, the permissible combined stress can be up to 0.42 fy.

Settlement characteristics of piles

5.05

Design piles such that the relative settlement between piles or pile groups under working load does not affect the performance of the superstructure. Except where otherwise specified, the settlement criterion is deemed to be satisfied if the pile under test load does not exhibit a total settlement in excess of that calculated in accordance with the formula in Clause 5.29 (iv).

Negative skin friction

5.06

- (i) The pile design calculations shall include for the effect of the negative skin friction (NSF), when appropriate, in accordance with the following formula:

$$\text{NSF} = 0.25 \times \text{Perimeter} \times \int_0^L P_v \times dL$$

Where:

L = Depth from ground level to top of dense alluvial sand or top of in-situ CDV or CDG. The depth stated on the Drawings has been taken from the existing ground investigation results and is given without warranty. The Contractor must satisfy himself of the validity of this information.

Perimeter = Perimeter of the pile, e.g. π x diameter for circular sections or 2 x (breadth + depth) for rectangular and H sections.

P_v = Effective vertical pressure (total pressure minus the hydrostatic pressure) taking the water table at the level stated on the Drawings.

dL = Elemental length.

- (ii) The above formula is provided as a minimum assessment. If this formula is not considered adequate, submit an alternative method of calculating the negative skin friction for SO's approval.
- (iii) For piles claimed to be non-negative friction (NF) pipe piles, the Contractor may adopt such methods of calculation in assessing the magnitude of the NSF approved when the system was registered by the Development Bureau.
- (iv) A pile group reduction factor of 0.85 may be applied to the evaluation of NSF under a pile group condition as defined in Clause 5.07.

Pile group reduction factor

5.07

Where five or more piles are placed under a structural element and in such proximity that the capacity of the piles to sustain the loading may be affected by other piles, a pile group shall be deemed to exist. A pile group reduction factor of 0.85 shall be applied to the calculated allowable load capacity of piles unless:

- (i) The centre-to-centre spacings are of more than 3 times the perimeter of the piles or the circumscribed rectangles in the case of H-piles; or
- (ii) The allowable load capacity of the piles is derived from end-bearing; or
- (iii) The piles are rock-socketed piles; or
- (iv) The piles are driven to refusal to rest on rock with final penetration not more than 1.0mm per blow.

Minimum spacing / nos. of piles	5.08	<ul style="list-style-type: none"> (i) The centre to centre spacing of piles shall normally be not less than the perimeter of the larger pile or 1 m, whichever is the greater. (ii) For piles bearing on bedrock as defined in Clause 5.19 (iv), the minimum clear spacing between the shaft surfaces of adjacent piles or edge of bell-outs shall be 1000mm. (iii) The centre to centre spacing of piles shall not be less than 750mm or 2 times the outer diameter, whichever is the greater for minipiles and the perimeter of the drill hole formed in bedrock for RSSHP. (iv) Minimum spacing requirement specified shall apply to spacing between newly installed and existing piles. (v) The centres of all driven piles and of all piles deriving their resistance mainly from friction shall be placed not less than half the length of the perimeter of the pile or 500 mm, whichever is the greater, from the site boundary. (vi) Except for large diameter bored piles, provide at least one pile under each column and at least two piles under each wall except noted otherwise.
Investigation for positions of piles	5.10	<ul style="list-style-type: none"> (i) Carry out necessary probing to ensure that piles may be installed to such depths as will sustain the required loading. (ii) Advise the SO immediately in writing when test probing indicates an area which will not permit piles to be installed to the required depth. Submit for approval proposals to support the relevant loadings. Provide all information regarding subsoil conditions considered necessary by the SO and calculations and drawings to demonstrate that any revision to the pile cap layout submitted in accordance with Clause 5.02 (i)(c) is the practical minimum. Backfill holes formed due to abortive installation of piles with granite fines or sand before adjacent piles are driven.
Energy reduction factor for followers	5.13	<ul style="list-style-type: none"> (i) Whenever followers are used, assess the energy reduction factor of each follower for each pile size. The energy reduction factor of the follower shall be taken as $= \frac{\text{Energy imparted to the pile immediately after the introduction of follower}}{\text{Energy imparted to the pile immediately before the introduction of follower}}$ (ii) The energy reduction factor for every combination of follower and pile size shall be determined from averaging the results of 5 sets of dynamic pile tests performed, at or near to, the set of 5 different piles of the same size. (iii) Dynamic Pile Test (DPT) is a test applied to a pile by impact, using falling weight, hammer or other percussive device. The response of the pile to the impact force is measured in terms of pile strain and pile acceleration or pile displacement. Take measurements at one level on the pile surface near the pile top.
Percussion piles	5.14	<ul style="list-style-type: none"> (i) Assess the allowable load capacity of the pile according to an approved dynamic formula, e.g. Hiley Formula. For the purpose of design calculation, the design factor of safety shall not be less than two.

- (ii) The design final penetration shall generally not be taken as less than 2.5 mm per blow. The set penetration of at least 10 blows shall be recorded on the Site during set. Where it can be demonstrated by DPT that the driving stress at final set is greater than 2 times the design working compressive stress for the allowable load capacity of the pile for steel H-piles, the design final penetration may be taken as not less than 1.0 mm per blow. The pile shall not be considered to have attained the allowable load capacity should the penetration of any blow recorded be in excess of the design final penetration.
- (iii) If the Hiley Formula is used to calculate the allowable load capacity of a pile, the temporary compression of the pile and hammer cushions (Cc) shall be taken as not less than 7.5 mm when the thickness of the hard wood packings at the pile head is 50 mm or less and the plastic hammer cushion is 200 mm thick or less (refer to Clause 5.18 for steel 'H' pile).
- (iv) The efficiency of the hammer (Eh) and the coefficient of restitution of the hammer cushion (e) shall be determined from/verified by carrying out Dynamic Pile Test (DPT) and CAPWAP analysis on trial piles (at least 5 piles for each hammer – pile size – drop height combination). Separate set of trial piles shall be carried out for founded piles with length difference exceeding 20m. For steel H-piles, the protruded length of all trial piles above ground shall not be greater than 3m and the measured driving stress of all trial piles in DPTs shall be greater than 2 times the design working compressive stress for the allowable load capacity of the pile as demonstrated with DPTs, and the 90% CAPWAP capacity of each trial pile shall not be less than twice the allowable load capacity of the pile. The combination of Eh and e shall be so chosen such that when these values are substituted into the Hiley Formula, the average of the predicted load capacity of the trial piles is not higher than 90% of the average CAPWAP capacity. If the measured driving stress at final set or 90% CAPWAP capacity requirements of each pile are not satisfied, the allowable load capacity of the piles shall be reduced and submitted for SO's approval.
- (v) If reasonable values of design final set (not less than 2.5 mm or 1.0 mm per blow as the case may be) cannot be obtained from the Hiley Formula with Eh and e so chosen and subject to the approval of the SO, all the piles falling into this category shall be subject to DPT and the allowable load capacity of the piles shall be assessed by CAPWAP analysis. For steel H-piles, the measured driving stress of the piles in DPTs shall be greater than 2 times the design working compressive stress for the allowable load capacity of the pile as demonstrated with DPTs. The pile shall not be considered to have attained the allowable load capacity should the 90% CAPWAP capacity is less than twice the allowable load capacity. In addition to the loading test requirements in Clause 5.29, the SO shall select 1% of nos. of piles (minimum one number) for each batch of piles proposed by the Contractor for phased completion to be load tested for acceptance. All the time and cost incurred from the DPTs, CAPWAP analyses and the additional loading tests shall be borne by the Contractor. Employ an Accredited Laboratory to carry out and interpret the DPTs, CAPWAP analyses and the additional loading tests. The Accredited Laboratory shall submit HOKLAS endorsed test reports directly to the SO in sealed envelopes within 14 days of the completion of the testing.
- (vi) Drop hammer shall not be used for final set measurement. All final sets shall be taken with the hydraulic hammer.

- (vii) Driving of the last segment of pile shall normally be in one operation and final set taken accordingly. If, for some reasons, this cannot be done, the rate of penetration of the pile shall be recorded before stopping. When pile driving is resumed, it shall be driven to attain at least the previous rate of penetration before final set is taken. In any case, a minimum of 20 blows of the same driving energy as at the previous final set shall be required before final set is taken. Such requirement might be waived unless it can demonstrate that the driving stress at the pile exceeds 0.9fy.
- (viii) If the protruding length of the pile above ground is more than 3m during the final set measurement, the measured temporary compression (Cp+Cq) shall be increased by 1mm per each metre increase beyond 3m. However, in all cases, the length of the protruding part of the pile above ground level shall not exceed 6m during the measurement of final set.
- (ix) The piles selected for DPTs (restrike test) shall be tested under the same driving conditions as in the final set measurement, i.e. same hammer, same hammer drop height and total length of pile not less than that at final set measurement. The set penetration of at least 10 blows shall be recorded and the measured driving stress of the piles shall be greater than 2 times the design working compressive stress for the allowable load capacity of the pile during the DPTs. If the measured final set values of the piles during the DPTs are more than that during the final set measurement, the allowable load capacity of these piles shall be assessed by CAPWAP analysis. All the time and cost incurred from CAPWAP analysis shall be borne by the Contractor.

**Precast
prestressed
tubular piles**

5.16

- (i) The piles must be of proprietary type manufactured and handled in accordance with the approved manufacturer's compliance standards. Stack piles neatly and securely off the ground.
- (ii) Submit to the SO manufacturer's certificates for each batch of piles delivered to the Site stating, (a) that the piles have been manufactured in accordance with the manufacturer's compliance standards approved by the Development Bureau, (b) that the piles are satisfactory for the purpose intended and, (c) the mix proportion and admixtures used in the concrete, and (d) the results of all cube and core tests.
- (iii) Carry out splicing to increase the pile length by welding the jointing plates of the lower and upper segments in accordance with the manufacturer's details. The welded joints shall be constructed, inspected and tested as described in Clause 5.18 (vi).
- (iv) Do not use a hammer of weight less than 50% of the weight of the pile during the final set. For set calculation in accordance with Clause 5.14 (iii), the temporary compression of the pile and hammer cushions (Cc) shall be taken as not less than 7.5 mm. If specified, carry out Dynamic Pile Testing or use other approved means to demonstrate at construction stage that the maximum tensile stress solely arising from pile driving does not exceed 12 MPa.
- (v) (a) When precast prestressed tubular piles are proposed, the SO will order at least one pile of each serial size from each batch, to be subjected to the following destructive tests:

(i) Taking Test Cores

3 sets of 3 cores (total 9 numbers) of 76 mm nominal diameter shall be taken, normal to the length of the pile, from 3 transverse sections of a sample pile selected by the SO.

(ii) Assessment of Core Strength

The compressive strength of the cores shall be adjusted for length/diameter ratio and direction of drilling ($D = 2.3$, to be considered as equivalent to cores drilled vertically) and converted to estimated in-situ cube strength in accordance with **CS1**.

The cores shall not be deemed to comply with the Specification if either:

- (a) The average strength of each set of 3 cores is less than 85% of the strength specified by the manufacturer, or
 - (b) The strength of any individual core is less than 75% of the strength specified by the manufacturer.
- (b) Unless otherwise specified, a batch of piles shall be 100 lengths or less of piles manufactured by the same manufacturer, covered by the same manufacturer's certificate delivered to the Site. Stock each batch of piles neatly as a group on the Site and each pile of a batch shall be identified with unique marking for approval.
- (c) In the event that the coring test results fail to comply with Clause 5.16 (v)(a)(ii) above, all piles of the same concreting date will be deemed to be unacceptable and shall be removed from the Site. Consequent to the failure of a coring test, two additional destructive tests shall be carried out to piles of different casting dates selected by the SO.
- (d) Supply sample piles for testing, arrange for all coring to be carried out by an approved specialist core drill contractor, and provide all necessary facilities and attendance. Grind the two ends of each core for compressive test smooth and truly perpendicular to the axis and deliver cores to the Public Works Laboratories (PWL) for testing. Prepare and submit test records to the SO and remove the cored piles off the Site on completion of the tests.
- (e) Do not use a pile from any batch until sample piles from such batch have passed the destructive test.
- (vi) Finish off the pile heads, cast concrete plugs and provide dowel bars in accordance with details shown at Annex "A".
- | | | |
|------------------------|-------------|---|
| Steel 'H' piles | 5.18 | <p>(i) Steel sections must comply with the requirement of BS EN 10025 Grade S275, S355JR or S450J0.</p> <p>(ii) Use steel sections with flange and web thicknesses not less than 20 mm.</p> <p>(iii) Testing of steel sections and accessories shall be as Section 15 – Structural Steel Work.</p> |
|------------------------|-------------|---|

- (iv) Notwithstanding Clause 5.18 (iii), 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 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 mark and deliver them to the Public Works Laboratories (PWL), as directed by the SO.

- (v) 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 fy.
- (vi) 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:
- (a) All welds shall be visually inspected to **BS EN 970**.
- (b) 10% of the welded joints shall be subject to ultrasonic examination to **BS EN 1714** Level B and magnetic particle inspection to **BS EN 1290**.

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 hours. 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 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 from the subsequent repair and re-test.

- (vii) Provide capping plates and dowel bars in accordance with the details shown at Annex "C".
- (viii) Unless otherwise specified, inspection and testing of welding, other than those shown on the typical splicing details and pile head details shown in Annex "B" and "C", shall be in accordance with Clause 15.58.
- (ix) Pile of same size but of different grades shall not be used in the same site.
- (x) 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.
- (vii) Provide capping plates and dowel bars in accordance with the details shown at Annex "C".

**Large diameter
bored piles** **5.19**

- (i) Large diameter bored piles are those of a diameter exceeding 750 mm formed by boring, chiselling or grabbing, plus filling with concrete.

Provide reinforcement and adequate ties in accordance with details shown at Annex "D".

- (ii) Site borings to pre-determine the level of oversite bedrock shall be carried out by an independent Ground Investigation Contractor from the List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Ground Investigation Field Work Category. One drill hole shall be sunk at each bored pile position, whereas 2 drill holes are required for pile diameter exceeding 2500mm. For this purpose, at least 5 m of continuous rock core samples of N size (61 mm diameter) shall be taken for inspection. Rock specimens shall be taken at top, middle and bottom along the length of rock core samples for point load test to determine the uniaxial compressive strength (UCS) of rock. Two copies of the drill hole logs shall be submitted directly to the SO by the Ground Investigation Contractor.
- (iii) Found pile on bedrock with a minimum embedment depth of 600 mm.
- (iv) Bedrock is defined as rock mass of at least 5 m thick and being Grade III or better rock (as defined in **GEOGUIDE 3**, "Guide to Rock and Soil Descriptions" prepared by Geotechnical Engineering Office and published by GIS, Hong Kong).

For design purposes, the maximum bearing pressure of piles on bedrock shall not exceed the following:

- (a) 3 MPa for Grade III or better rock with total core recovery greater than 50% for any one metre within the rock mass.
- (b) 5 MPa for Grade III or better rock with total core recovery greater than 85% for any one metre within the rock mass and minimum uniaxial compressive strength (UCS) not less than 25 MPa (equivalent point load index strength PLI_{50} not less than 1 MPa).
- (c) 7.5 MPa for Grade II or better rock with total core recovery greater than 95% for any one metre within the rock mass and minimum uniaxial compressive strength (UCS) not less than 50 MPa (equivalent point load index strength PLI_{50} not less than 2 MPa).

The point load index strength of rock is the equivalent value for 50 mm diameter cores.

- (v) Do not use piles with enlarged bases unless specified otherwise. Where so permitted, the Particular Specification for Large Diameter Bored Piles with bell-out shall be referred to. The relevant technique shall have been approved by the Development Bureau.
- (vi) The requirements of Clause 5.17(ii) apply equally to large diameter bored piles.
- (vii) Where the water level is higher than the bedrock level, carry out concreting with a tremie pipe. Clean the pile base by air lift before commencing concreting. Ensure the tremie pipe always penetrates well below the top level of the concrete being poured.

- (viii) Supply concrete in sufficient quantities to ensure that concreting of each pile proceeds without interruption. The concrete shall have a minimum cement content of 400 kg/m³ and a minimum slump of 150 mm.
- (ix) Where the water level is higher than the bedrock level, the concrete used shall have grade strength 25% higher than the design grade strength.
- (x) Where a pile is founded on a stratum which deviates from the predicted depth by more than 4 m, carry out additional borings to satisfy the SO that the pile is acceptable.
- (xi) When defects such as voids, unbound sediment or segregation of concrete are observed at the base of the pile, the Contractor shall carry out remedial works to rectify such defects as approved by the SO.

The Contractor shall first submit a method statement for SO's approval. Remedial works shall, inter alia, consist of further drilling to determine the extent of the defects, cleaning by high pressure jetting and subsequent pressure grouting. After completion, the Contractor shall carry out verification coring to prove all defects are properly filled with grout.

- (xii) Where steep bedrock profile is identified, the founding levels of adjacent piles shall not differ by more than the clear distance between the pile bases unless the stability of rock under the piles are checked by recognized engineering principles, taking into account the existence of any adverse joints.
- (xiii) For large diameter bored piles with diameters greater than 2000 mm, reversed circulation drill (RCD) must be used to set the pile shaft in rock and smooth out the rock surface. Should a similar machine and equipment that achieves equivalent results and of equal performance to that of the RCD be proposed, the Contractor shall demonstrate to the satisfaction of the SO before submitting for approval.

Minipiles

5.21

- (i) Minipiles are those consisting of a steel permanent casing with internal diameter not greater than 400 mm, with either one or a group of steel reinforcing bars in the middle as the load bearing element, and the remaining cavity filled with grout. The core of the minipile shall be socketed into bedrock.
- (ii) The allowable load capacity of the individual pile shall not exceed 1400 kN.
- (iii) The allowable load capacity of the individual pile shall be the design bond strength between the bedrock and grout times the design length and perimeter of the rock socket, or the design bond strength between the reinforcement and grout times the effective perimeter of the reinforcement and design length of the rock socket, or the allowable reinforcement compressive capacity designed in the pile, whichever is the smaller. The steel permanent casing and the grout shall not be taken into account in the calculation of pile capacity.

End bearing capacity of the pile shall be ignored.

The Contractor shall satisfy himself that the above method of calculating the allowable load capacity provides a sufficient factor

of safety in his design. Should he feel that this method does not provide an adequate factor of safety in his design, he shall submit an alternative method of calculation for the approval of the SO.

Design bond strength between bedrock and grout shall not exceed 0.7 MPa for grout having minimum cube strength of 30 MPa at 28 days and 0.64 MPa for grout having minimum cube strength of 25 MPa at 28 days. Bedrock is defined in Clause 5.21(xx). If a different bond strength value is proposed, submit the details of the design parameters, proposed testing methods of the trial piles (including loading tests) for justification of the proposed parameters and test programme, all to the satisfaction of the SO. All tests for this purpose shall be at the Contractor's own expense and no extension of time shall be granted whatsoever.

The maximum allowable compressive stress of the reinforcement shall not exceed 205 MPa for ribbed steel reinforcing bars in Grade 500. The maximum allowable bond stress between grout and reinforcement for ribbed steel reinforcing bars in Grade 500 shall not exceed 0.8MPa. In calculating the allowable load capacity of the pile due to bond, the effective diameter of a group of bars (with spacing between adjacent bars less than 25mm) shall be equivalent to the diameter of a bar of equal total area.

- (iv) The pile shall not be designed to resist any horizontal loads unless designed as raking piles. If raking piles are used to resist lateral loads, they should only be designed to resist the lateral load. That is, no vertical load should be considered to be taken by the raking pile if it is designed to take lateral load. The sub-grade reaction of soil shall be ignored in raking pile calculations.
- (v) Group reduction factor in Clause 5.07 shall not be applied.
- (vi) Steel reinforcing bars shall comply with Section 6. Mechanical couplers shall be of type 1 mechanical couplers conforming to the Code of Practice for Structural Use of Concrete and shall comply with the Particular Specification for Mechanical Couplers.
- (vii) The steel reinforcing bars may be lengthened by staggering the couplers with details approved by the SO. The percentage of the total cross sectional area of steel reinforcing bars lengthened by couplers at any one section shall not be greater than 50% and the couplers should normally be arranged symmetrically with minimum spacing between couplers of 500 mm c/c along the pile. Also, mechanical couplers shall not be used within the prebored hole formed in bedrock.
- (viii) Separate each reinforcing bar by spacers of 16 mm minimum size at regular intervals not greater than 2000 mm. Unless agreed by the SO, the minimum length of each reinforcing bar shall be 6 m except the uppermost section. Lapping and spacers details shall be submitted for SO's approval.
- (ix) Minimum cover to reinforcement inside the prebored hole formed in bedrock shall be 35 mm. For other part of the pile, minimum cover to reinforcement shall be 40 mm or the diameter of reinforcement whichever is the greater.
- (x) Provide and calculate the minimum lengths of rock socket using Clause 5.21(iii). Grout all piles to a minimum level of 300 mm above the specified pile cut-off level.

- (xi) Pile shall be installed without use of bentonite slurry or other drilling muds.
- (xii) Use air as the flushing medium during the drilling operation. Water shall not be used as the flushing medium. The Contractor's attention is drawn to the formation process of the pile shaft using air flushing where special care shall be taken to avoid caving in of soil during forming of the pile shaft.
- (xiii) Permanent casings for piles shall be provided and shall meet the following requirements:-
 - (a) Pile shafts shall be cased for their entire length against soil plus a projection of at least 500 mm into bedrock or such other depth as required avoiding caving in of soil at the interface of soil and bedrock during cleaning of the rock socket.
 - (b) The casings shall be formed of steel of 5 mm minimum thickness with an internal diameter not less than the specified pile diameter. The casings shall be joined where necessary with watertight joints. The casings shall be clean and free of any material adhering to them when first inserted into the pile position
 - (c) Permanent casings shall be Grade S275J0H or S275J2H structural steel complying with Section 15. The casings shall be free from significant distortion and shall be of uniform cross-section throughout the whole length and be free from internal projections, which might prevent the proper formation of the piles. Dents in the casing shall not exceed 5 mm in depth.
- (xiv) Use the Symmetrix system (either with the pilot bit set back from or advanced ahead of the ring bit during drilling), Odex system or other drilling systems approved by the SO to form the pile hole of the minipiles. Unless the Symmetrix system with special arrangement in which the pilot bit is set back from the ring bit (i.e. the pilot bit is covered by the ring bit) during drilling is adopted, the Contractor shall properly fill the gap between the casing and soil with grout or other means. Submit a method statement detailing the proposed procedures and materials to be used for filling the gap between the casing and soil for the approval of the SO before the commencement of works.

Test drilling shall be carried out to confirm safety and suitability of the proposed drilling method and equipment and the control parameters proposed in the drilling method. The drawdown of ground water table and ground settlement induced by the drilling operation should be assessed for reviewing of the proposed drilling operation.
- (xv) Drillholes for pile shall not be oversized by more than 20 mm.
- (xvi) Founding level of piles shall be taken as the top level of bedrock.
- (xvii) Before commencement of piling, take N size cores to either 5m or the length of rock socket plus 500mm thick, whichever is the greater, into bedrock to establish the bedrock level. Rock specimens shall be taken at top, middle and bottom along the length of rock core samples for point load test to determine the uniaxial compressive strength (UCS) of rock. This predrilling shall be carried out by an independent Ground Investigation Contractor and in sufficient number such that any pile tip shall not be more than 5

m away from the nearest drill hole. Allow sufficient time for additional drill holes when in the opinion of the SO that the bedrock profile cannot be reasonably established from the data of the completed drill holes. All reports shall be submitted directly to the SO in sealed envelope from Ground Investigation Contractor. Submit two copies of the bedrock contours to the SO within 3 days of the predrilling.

- (xviii) When the founding level has been reached, collect rock samples at the top, bottom and intermediate intervals along the length of rock socket for inspection. The spacing of rock samples collected shall not be more than 1.5m. The rock samples shall be stored in plastic bags with labels showing the pile number and retrieval levels. The Contractor's Construction Supervisor for piling works shall sign on the plastic bags after inspecting the samples. The actual founding level of piles shall be agreed with the SO before the commencement of rock socket boring. The method of measuring the founding level and pile toe level of piles shall be agreed with the SO before the measurements are taken.
- (xix) Proof drilling shall be carried out by an independent Ground Investigation Contractor to verify the adequacy of the socketed length of piles at locations instructed by the SO. The number of proof drilling shall be at least 2 or 1% of the number of piles rounded up to the next higher whole number, whichever is the greater. The depths of the proof drill holes shall be at least 5 metres or the length of rock socket plus 500mm below the founding levels of the adjoining selected piles, whichever is the greater. All reports shall be submitted directly to the SO in sealed envelope from Ground Investigation Contractor.

If the core taken from the proof drilling at the position indicates that the bedrock level is more than 1m deeper than that adopted for the installation of the adjoining selected pile, the Contractor shall further investigate the difference of bedrock levels including carrying out additional proof drillings. The Contractor shall submit an assessment report with a rockhead contour plan based on the ground investigation to confirm the adequacy of the pile construction.

- (xx) Bedrock is defined as rock mass of at least 5m or the length of rock socket plus 500mm thick, whichever is greater and being Grade III or better rock as defined in Clause 5.19 (iv)(b).
- (xxi) Grout material shall meet with the following requirements:-
 - (a) Grout shall consist of ordinary Portland cement and water with an approved non-shrinkage additive. Either PFA or GGBS may be used in combination with Portland cement. The proportion of PFA and GGBS replacement shall be in accordance with Clause 6.30. Other admixtures can be used when approved by the SO. The manufacturer's guidance shall be strictly followed. Cement sand mix is not allowed.
 - (b) Grout shall have minimum cube strength of 25 MPa or 30 MPa at 28 days. Grout having minimum cube strength less than 25 MPa shall not be accepted.
 - (c) Measurements for bleeding shall be taken at 15-minute intervals. The amount of bleeding shall not exceed 2% at the end of the first 3 hours and no interim readings shall exceed 4%. In addition the water must be reabsorbed by the grout within 24 hours after mixing.

- (d) Free expansion of grout when measured at the end of 24 hours after mixing shall have a figure between 0% and 5%. A negative percentage figure shall not be accepted.
- (e) Any approved admixtures shall be chloride-free and comply with BS EN 934.
- (f) 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%.
- (g) Water for grout shall be clean fresh water having a temperature not exceeding 30°C nor less than 5°C.

- (xxii) Mix grout material by weight batching. Measure the amount of water used by a calibrated flowmeter or a measuring tank.

The mixing time in high-speed mixers shall be appropriate for the type of mixer used.

After mixing, the grout shall be continuously agitated in a holding tank and screened before injection. The grout shall be placed within the time limits specified by the manufacturers of the additives.

- (xxiii) Before grouting, clean the bottom of the hole by airlifting or an alternative method approved by the SO.

Agree with the SO the method to measure the grout intake volume.

Grouting of the pile shall be in one continuous operation and under no circumstances shall a pile be left partially grouted.

No un-grouted rock sockets shall be closer than 3m from a pile being grouted.

Properly cover and fence off newly grouted piles.

- (xxiv) Carry out grouting in such a way that the lowest part of the grout pipes shall be as close to the pile toe as possible and, unless agreed by the SO, the grout pipes shall not be lifted up before the completion of grouting.

- (xxv) Testing of Grout

Employ an approved independent laboratory to carry out the tests for Bleeding, Free Expansion and Flow Cone Efflux of grout. All test reports shall be submitted directly to the SO in sealed envelope from the approved laboratory.

To the satisfaction of SO, test results shall be checked by periodic verification using another approved laboratory to conduct identical testing of grout from the same samples, selected by the SO.

- (a) Test for Bleeding and Free Expansion

Provide one sample of the grout from each pile after mixing and protect from changes in moisture content before tests are carried out.

Each sample shall be divided into 3 specimens. Each specimen is to be placed in a covered cylinder with a diameter of 100 ± 10 mm to

a depth of 100 ±5 mm and the amount of bleeding and free expansion is measured by a scale fixed to the outside of the cylinder.

$$\text{Bleeding} = 100\% \times \frac{H_2 - H_g}{H_1}$$

$$\text{Free Expansion} = 100\% \times \frac{H_2 - H_1}{H_1}$$

where H_1 - initial height of grout sample
 H_2 - height of sample measured at upper surface of water layer or hardened grout surface if water is fully absorbed
 H_g - height of grout portion of sample at upper surface of grout

Submit all preliminary test results directly to the SO in sealed envelope from the approved laboratory within 48 hours after the mixing of grout.

If the result of the bleeding test of the grout for any pile does not comply with the specified requirements or the free expansion of the grout for any pile is greater than the specified upper limit, the Contractor shall propose changes to improve the materials, grout mix or method of production, though the failure does not constitute a failure of the pile.

If the free expansion of the grout for any pile has a negative figure, the Contractor shall carry out test(s) at their own expense to demonstrate that the pile can fulfil the original design requirements.

(b) Flow Cone Efflux Test

At least one sample from each pile shall be taken and tested in accordance with ASTM C939 to determine the Flow Cone Efflux time. Agree with the SO the frequency of the test.

Except with SO's prior agreement for grout mixes containing additives, grout having an efflux time of less than 15 seconds will be rejected.

(c) Test for Crushing Strength

Provide one sample of the grout for each pile after mixing and protect it from changes in moisture content before making test cubes.

Cubes shall be prepared using 100mm cube moulds.

Make two cubes from the sample. Strength compliance requirements shall follow Clause 6.55.

- (xxvi) Install and maintain ground settlement and building settlement markers on site. The numbers and locations of these markers shall be determined by the SO. Employ an approved independent registered professional surveyor to carry out bi-weekly surveys of the settlement markers during the entire piling construction period. Submit 3 copies of the survey results to the SO within 3 days of the surveying. All survey reports shall be submitted directly to the SO in sealed envelope from the approved surveyor.

(xxvii) Environmental Control

The Contractor shall keep the Site clean and tidy during the construction period. He shall submit a method statement in reducing the nuisance such as noise, dust, waste water, and deposition of excavated material on public roads by dump truck during haulage to meet EPD's latest environmental requirements for the SO's approval before the commencement of works.

The Contractor shall carry out Daily Cleaning in accordance with the Particular Specification for Daily Cleaning and Weekly Tidying. For the purpose of this clause, "waste materials" stated in the above particular specification shall also mean the material retrieved from the pile shaft during the course of boring. Attention is drawn to the prevention and removal of water ponds, and clearing of stockpiling and waste arising from the Works.

The Contractor shall apply for a Wastewater Disposal Licence under the Water Pollution Control Ordinance and no wastewater shall be discharged into communal sewers, storm drains, river courses or waterbodies until the said Licence is granted by EPD and relevant authorities. Provide, operate and maintain suitable works for the treatment and disposal of the wastewater to meet the requirements stated in the said Licence.

Temporary site drainage to keep the site clear of water and prevent nuisance due to run-off onto adjacent land to be submitted for SO's approval.

Store cement in bags in a dry, weatherproof store with a raised floor. The storage area for more than 20 bags of cement shall be covered entirely by impervious sheeting or sheltered on the top and the 3 sides.

The set up of grout batching plant shall be properly designed to minimise dust emission and provide sufficient ventilation for workers.

In addition to the use of hung tarpaulin or similar fabric sheets, provide suitable device to the satisfaction of the SO near the top of the casing at all times during the boring of pile shaft to mitigate the scattering of the excavated material from the pile shaft.

During the course of boring, the retrieved material shall be wetted before being flushed out from the pile shaft.

(xxviii) Safety of Air Receiver, Compressor and Hoses

The use of air receiver and compressor shall be in accordance with the Boiler and Pressure Vessels Ordinance (The Ordinance) and Regulations, and the Code of Practice for Pressure Equipment Owners published by the Boiler and Pressure Vessels Authority, Labour Department. For the purpose of this clause, the "appointed examiner" shall be the person defined in the Ordinance.

Every air receiver together with its fitting, attachments and hoses once delivered to site shall be examined by an appointed examiner prior to its operation on site. During the examination, the hoses shall be connected to the maximum length intended to be used. The air receiver shall not be used until:

- (a) the appointed examiner is satisfied that the air receiver and its associated fitting, attachments and hoses are of sufficient strength to withstand the maximum permissible working pressure to which they may be subjected; and,
- (b) a certificate of fitness for the air receiver as stipulated in the Ordinance is issued accordingly by the appointed examiner and submitted to the SO.
- (c) A written report is issued for the fitness of the hoses.

Every air compressor on site shall have a valid certificate of fitness (for its internal air receiver).

The air receiver and compressor shall not be operated at a pressure greater than their maximum permissible working pressures specified in the latest certificates of fitness.

A copy of the certificate of fitness shall be attached to the air receiver and compressor.

The air receiver shall not be used until it is re-examined by the appointed examiner if:

- i. the seal attached to a safety valve has been broken, or the setting of a safety valve has been altered,
- ii. the air receiver has been repaired extensively,
- iii. the certificate of fitness has expired.

Where appropriate, the whip-checks shall be properly installed at hose connection points. The first whip-check shall be directly attached to the main body of the air receiver/compressor.

Every shut-off valve connected to the air receiver shall be fitted with a non-return valve, and shall be closed when the piling plants are idling. The use of elbow connectors to connect hoses to air receiver or compressor is not allowed.

During the course of piling works, every compressor, air receiver and their auxiliary equipment, including the connecting hoses, shall be properly inspected and recorded daily for the integrity of the system before the commencement of works by a designated competent person who shall be assigned by the Contractor and shall have at least 3 years' experience in the maintenance of similar systems. The daily inspection records shall be kept by the Contractor for the examination of the SO. The appointed examiner shall be consulted whenever necessary. If any defect is found, it shall be rectified immediately prior to operating the air receiver system.

Attendants shall be present to look after the compressed air system during the operation of the air receiver and compressor. The system shall be shut down after the work.

The routings of hoses shall not present a hazard or obstruct access and shall be routed away from any areas where they may be vulnerable to mechanical damage.

Include in the Safety Plan a maintenance programme for the compressed air system. Tool-box Talk and Job Specific Training on the potential hazards and safe use of the compressed air system shall be conducted to all relevant site personnel and workers.

The Contractor shall prepare risk assessment for the use of the compressed air system, and review the safety procedures and control measures for the operation of the compressed air system periodically or after there is a material change in connection with the plant, process, material and environment.

**Rock-socketed
Steel H-piles**

5.22

- (i) Rock-Socketed Steel H-piles (RSSHP) are those in which a steel H-section is installed within a prebored hole formed into bedrock and then grouted with cement grout. The prebored holes shall be large enough to facilitate the installation of H-piles and to allow sufficient cover for corrosion protection purposes.
- (ii) The allowable load capacity of individual pile shall not exceed 5500 kN.
- (iii) The allowable load capacity of individual pile shall be the design bond strength between bedrock and grout times the area of contact between the rock and grout below the effective rock socket top level as defined in Clause 5.22(xi), or the design bond strength between the pile and grout times the total area of contact between the pile and grout below the effective rock socket top level as defined in Clause 5.22(xi), or the allowable axial force of the steel H-pile section, whichever is smaller. The maximum allowable axial working stress of steel H-pile sections shall be 45% of the yield stress and the combined stresses due to axial load and bending moments shall be limited to 50% of the yield stress. When the calculations of stresses are based on all loads including wind loads, the permissible stress shall be increased by 25% of the above stresses.

End-bearing capacity of the pile shall be ignored.

The Contractor shall satisfy himself that the above method of calculating the allowable load capacity provides sufficient factor of safety in his design. Should he consider that this method does not provide an adequate factor of safety in his design, he shall submit an alternative method of calculations for the approval of the SO.

Design bond strength between bedrock and grout shall not exceed 0.7 MPa for grout having minimum cube strength of 30 MPa at 28 days and 0.64 MPa for grout having minimum cube strength of 25 MPa at 28 days. Bedrock shall be that defined in Clause 5.21(xx). If different bond strength value is proposed, submit details of the design parameters, proposed testing methods to the trial piles (including loading tests) for justification of the proposed parameters and test programme to the satisfaction of the SO. All tests for this purpose shall be at the Contractor's own expense and no extension of time shall be granted whatsoever.

The maximum allowable average bond stress between grout and steel H-pile shall be 0.5 MPa for grout having minimum cube strength of 30 MPa at 28 days and 0.45 MPa for grout having minimum cube strength of 25 MPa at 28 days when the shear bars details shown in Annex "E" is applied.

- (iv) Unless specified otherwise, the horizontal loads given in the loading schedule shall be taken by the piles. The effect of rock socketing on the lateral stiffness of the pile may be assessed as given in “Pile Foundation Analysis and Design” by Poulos H.G. and Davis E.H. (1980).
- (v) Raking piles shall be designed to resist lateral loads only. The sub-grade reaction of soil shall be ignored in raking pile calculations.
- (vi) Provide capping plate and dowel bars in accordance with the detail as given in the GS for steel ‘H’ piles. The design of steel capping plates and their connections shall be in accordance with **Code of Practice for the Structural Use of Steel**.
- (vii) The minimum clearance (cover) between casing and the steel H-pile shall be 40mm. Spacer details shall be submitted to the satisfaction of the SO.
- (viii) Only one steel H-pile in an individual socket shall be accepted.
- (ix) The minimum length of each pile segment forming the whole length of pile shall be 10 m except the uppermost section.
- (x) Provide shear bars to steel H-piles within the rock socket in accordance with the details shown in Annex “E”.
- (xi) Effective rock socket top level is the bottom level of the temporary casing.

The minimum lengths of rock socket below the effective rock socket top level shall be calculated from Clause 5.22 (iii)
- (xii) The entire shaft shall be filled solid with grout, without voids, honeycombing or other defects, up to a level of between 150mm and 450mm above cut-off level.
- (xiii) Special care shall be taken to the formation process of the pile shaft using air flushing to avoid caving of soil in forming the pile shaft. The use of bentonite slurry or other boring muds shall be prohibited for the pile installation.
- (xiv) Temporary casing of approved quality shall be lowered at the same time when the hole is made. The embedded depth of temporary casing below the founding level (casing embedded depth) shall be 500 mm minimum or such other depths as required to avoid caving of soil at the interface of soil and bedrock during cleaning of the rock socket.

Temporary casing shall be free from distortion, internal projections and hardened grout.

Extraction of temporary casing shall be carried out only after the completion of grouting. Partial extraction of temporary casing before the completion of grouting shall only be carried out with the approval of the SO.
- (xv) The temporary casing of raking pile shall not be extracted.
- (xvi) In case the temporary casing, other than that of raking pile, cannot be extracted for whatever reasons, pressure grouting shall be carried out at the peripheral of the temporary casing to fill up the gaps between the pile and surrounding soils, otherwise the

horizontal load carrying capacity of the pile shall be ignored and the Contractor shall revise the design accordingly. Submit method statement of pressure grouting for the approval of the SO.

- (xvii) Concentric drilling system, e.g. Symmetrix or equivalent, shall be used for drilling. The Contractor shall submit details of the drilling machine to be used, including the complete operating mechanism of the drill bit, the range of anticipated rates of advancement of the drill bit (including the procedures for monitoring) and the maximum volume of the air supply and pressure to be applied in different soil and rock strata for the approval of the SO before commencement of any drilling works.

Clause 5.21 (xiv) on test drilling shall apply equally to RSSHP.

- (xviii) Clause 5.21 (xvi), (xvii), (xviii) and (xix) on founding level shall apply equally to RSSHP.

- (xix) Clause 5.21 (xxi), (xxii) and (xxiii) on grout shall apply equally to RSSHP.

- (xx) Grouting shall be carried out with two non-flexible grout pipes, one at each side of the web of the steel H-pile. The lowest part of the grout pipes shall be as close to the pile toe as possible and, unless agreed by the SO, the grout pipes shall not be lifted up before the completion of grouting.

- (xxi) Clause 5.21 (xxv) on testing of grout shall apply equally to RSSHP.

- (xxii) 10% of the total no. of piles shall be subject to core testing on the hardened grout. Take a 84 mm nominal diameter core down to the bottom of the pile in the hardened grout for examination and testing. For a core taken at a level deeper than 50m, the diameter of the core shall be 76mm and a triple barrel coring shall be used for core sampling. To facilitate such coring, one mild steel tube terminated at 0.6 m above the founding level and of 150 mm internal diameter sufficient for coring shall be fixed to every pile in the manner as specified in Clause 5.36 (i) to (vii). The tube shall be filled with water before grouting. All tubes shall be filled up by pressure grouting upon completion of all testing.

- (xxiii) The pile shall be deemed to have failed the coring test if :-

- (a) The concrete core exhibits honeycombing which means interconnected voids arising from, for example, inadequate compaction or lack of mortar ; or
- (b) When any sample section of the core with length/diameter ratio of 1.2 is taken for compressive testing, the sample has an estimated in-situ cube strength converted in accordance with CS1 from the compressive strength of the grout core, less than 75% of the specified cube strength.

- (xxiv) When a pile fails a coring test, the following procedures shall be followed:

- (a) The Contractor shall carry out remedial measures in accordance with Clause 5.31. In addition, further coring tests shall be carried out on two other piles. The cost of the additional coring tests shall be borne by the Contractor; or

(b) The Contractor shall carry out a loading test on that pile in accordance with Clause 5.29 to test for acceptance. The cost of the loading test shall be borne by the Contractor. The pile would be accepted if it passes the loading test, otherwise, the pile shall be deemed a failure and remedial measures shall then be carried out in accordance with Clause 5.31. In either case, further coring tests shall be carried out on two other piles and the cost of the additional coring tests shall be borne by the Contractor. In addition, if a pile fails a coring test in accordance with Clause 5.22(xxiii)(a), pressure grouting of pile to fill up the honeycombing shall be carried out before the acceptance of the pile.

(xxv) Clause 5.18 (i), (ii), (iii), (iv), (vi), (vii), (viii) on Steel H-pile shall apply to RSSHP.

Employ an approved independent testing firm to carry out and interpret the inspection and testing of welds, and provide any necessary labour and attendance. Submit evidence proving that operators carrying out the inspection and testing have been trained and assessed for competence in the inspection and testing of welds. In addition, submit certificates of competence from a recognised authority for operators carrying out ultrasonic examination. All test reports shall be submitted directly to the SO in sealed envelope from the independent testing firm within 3 days of the completion of the testing.

The welded joints of piles shall not be lowered into the pile shaft within one hour after they are completed.

The maximum length of spliced pile sections in horizontal or inclined positions shall be 24 m.

(xxvi) Clause 5.21(xxvi) in monitoring of ground and building settlement shall apply to RSSHP.

(xxvii) Clause 5.21(xxvii) on environmental control shall apply to RSSHP.

(xxviii) Clause 5.21(xxviii) on safety of air receiver, compressor and hoses shall apply to RSSHP.

(xxix) Safety Requirements of Cranes on Casing Extraction

Unless otherwise agreed by the SO, casing extraction shall be carried out by a vibrating pile extractor. The Contractor shall submit method statement of casing extraction for the agreement of the SO.

The test, examination, use and maintenance of a mobile crane suspending a vibrating pile extractor for casing extraction, together with the associated lifting gear, shall be in accordance with the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations.

The maximum safe working load (SWL) at the specified operating radius of the crane shall be ample enough to take the weight of the extractor and its vibrating load transmitted through the absorber to the crane, the weight of the casing to be extracted and the frictional force between the soil and the casing during the extraction.

The maximum SWL shall be taken from the data specified in the Form 3 of the Factories and Industrial Undertakings (Lifting

The operator of the crane shall possess a valid crane operator certificate. Prior to the casing extraction, the operator shall be briefed by the Contractor's Construction Engineer on the weight and depth of the casing to be extracted. The crane shall be operated with great care. The extractor shall be effected by a smooth pull on the hoist line and under no circumstances shall the hoist rope be jerked, boom swung or the machine tipped to free entanglement and achieve faster results.

Tolerances in setting out of piles 5.23

- ## Effect of vibration on adjacent structures and

- (i) Vibration caused by piling work shall not exceed the maximum peak particle velocity of ground movement of 7.5 mm/second and 15 mm/second for water retaining structures and water mains

services

respectively, as measured with a vibroscope. Comply with restrictions on particle velocity caused to adjoining structures as specified.

- (ii) When specified, install "Test piles" before general piling work commences in order to establish the vibration caused by the proposed piling system. "Test piles" will be piles, selected by the SO, which are adjacent to any water mains or water retaining structures and the like. The maximum peak particle velocity shall be recorded at every meter length of penetration of pile, at final set and at levels where obstructions are encountered. Should vibrograph measurements reveal that the specified vibration levels are being exceeded, cease piling and revise the method of driving or the proposed pile system to ensure that the levels of vibration created are reduced to within the specified limits.
- (iii) Should any unrecorded water main or similar be located during the construction period, vibrograph measurements shall be taken to establish the vibration caused by the piling system adopted. Should the vibrograph measurements reveal that the specified vibration levels are being exceeded the general principles contained in Clause 5.24 (ii) above will apply.
- (iv) Provide and retain on the Site, until completion of installation of piling, all necessary equipment for the taking of vibrograph readings to ascertain vibration levels. The vibrograph must be of a type that produces a permanent printed record of the vibration created. Provide experienced personnel for the carrying out of vibrograph readings and give the SO at least 48 hours notice before taking measurements. Provide the SO with a copy of each vibration record.

Cutting off pile heads 5.25

- (i) The cut off levels of piles shown on the tender drawings are tentative and may be altered if so required by the SO.
- (ii) Excavate to expose, trim and cut off pile heads to the specified levels.
- (iii) For steel piles, execute cutting by approved means. In the event of damage being made to the head of the pile, cut off the defective parts and make good the pile to the satisfaction of the SO.
- (iv) Score or chase around concrete piles at cut off level to an approved depth prior to removing pile heads to ensure that concrete below cut off level is not damaged. Cut away and make good cracked or defective concrete with new concrete properly bonded to the old. Rectify displaced dowel bars.

For precast prestressed tubular piles, the cutting off shall be by means of an abrasive disc.
- (v) Allow a minimum of seven days between the completion of casting an in-situ concrete pile and the cutting off of the pile head.

Note: (a) For large diameter bored piles, cast concrete at least 0.75 m above the cut off level such that surface laitance may be removed at completion of concreting leaving sound concrete at cut off level.
(b) For other cast in-situ piles, the height of concrete cast above the cut off level should be sufficient for maintaining the pressure head as required by the system.

Pile caps, tie beams and dowel bars

5.26

(i) Unless otherwise specified, pile caps, strap and tie beams are part of the Works.

(ii) (a) All pile caps, strap and tie beams shall be designed by the Contractor to **Code of Practice for Structural Use of Concrete**, for the worst combination of load cases. The design shall be certified by a Registered Structural Engineer.

Where specified, design tie beams to tie all columns in both directions to take care of moments due to eccentricities between load centre and centroid of pile or pile group underneath. The eccentricities shall not be taken as less than 75 mm in any case.

(b) All concrete works for pile caps and strap beams shall be to Section 6 of General Specification. Structural concrete shall come from a supplier registered under the Quality Scheme for the production and supply of concrete.

(c) PFA or GGBS concrete shall be used in all pile caps and substructure construction where the concrete structural elements bear a least dimension over 750 mm. The proportion of PFA or GGBS of the total cementitious content in such concrete shall be in accordance with Clause 6.30.

(d) A 50 mm blinding layer of grade 10/20 concrete shall be laid prior to casting of pile caps and strap beams.

(e) Steel bars shall be plain steel reinforcing bars (denoted by R), Grade 500B or 500C ribbed steel reinforcing bars (denoted by T) to Hong Kong SAR Construction Standard CS 2. All reinforcement shall be cut or bent to comply with **BS 8666** unless otherwise specified.

(f) Cover to all bars including links and stirrups shall be 50 mm.

(g) If large concrete rafts are to be constructed:

(i) Allow sufficient chairs to support top reinforcement in rafts.

(ii) The positions and method of forming construction joints including sample treatment are to be submitted for approval prior to work on site.

(iii) For concrete in large pile caps and piled rafts, measures should be taken in temperature curing to minimize temperature differential occurring in the concrete sections. The side formwork shall not be removed during the curing and as soon as the concrete is cast and bleeding water disappears, the surface shall be cured for a minimum of 4 days by either:

Covering the concrete with a layer of fine aggregate, minimum 25 mm thick, and keep it constantly wet, or

Covering the surface with one layer of 50 mm thick polystyrene boards secured with canvas on top.

(h) Where specified in the Contract, the Particular Specification for Reinforced Massive Concrete Structures shall apply.

- (iii) Provide dowel bars as specified.
- (iv) Thoroughly wire brush the dowel bars to remove all rust, scale, adhered mud and the like, and prepare and apply a thick protective coat of approved cement grout on all exposed areas of the dowel bars.

Backfilling

5.27

- (i) Backfill pits after cutting off pile heads if the construction of pile caps does not follow immediately.
- (ii) Compact all fill around pile caps and tie beams to not less than 90% of the maximum dry density determined in accordance with test method 10.2 or 10.4 of Geospec 3 – Model Specification for Soil Testing issued by the Geotechnical Engineering Office as directed by the SO. Determine the in-situ field density in accordance with Geospec 3, test method 11.1 or 11.2, as directed by the SO.
- (iii) Remove all surplus excavated materials from the Site.

Report sheets

5.28

Forward daily to the SO in duplicate, report sheets for piles formed the previous day, giving for each pile its identity number, size, gross and nett length together with the serial number of rigs or machines used, and information on any obstructions or special phenomena met during the formation of the piles. Provide the following data for the appropriate type of pile:

<u>Type of piles</u>		<u>Particulars</u>
(i)	Precast concrete pile, and precast prestressed tubular pile	(a) Date pile or segment (with serial number) cast;
		(b) Length of pile before cutting off;
		(c) Hammer weight and type;
		(d) Drop of hammer;
		(e) Type and length of "follower" adopted if applicable;
		(f) Penetration record (number of blows per 300 mm penetration) for the full length of piles, for the number of piles selected by the SO;
		(g) Final sets for the last 10 blows;
		(h) Field record of temporary compression at the final set stage (by recording on a card or graph paper attached to the face of the pile while drawing a pencil along a straight edge placed against it).
(ii)	Percussion cast in-situ concrete pile	(a) Length of the steel tube;
		(b) Hammer weight and type;
		(c) Drop of hammer;
		(d) Penetration record for the full length of pile, for the number of piles selected by the SO;
		(e) Final sets of the last 10 blows;
		(f) Field record of temporary compression at final stage;
		(g) Volume of concrete cast;

- (h) method of compacting concrete;
 - (i) Casting time on completing each pile.
 - (iii) Steel 'H' pile
 - (a) Length of steel 'H' pile before cutting off;
 - (b) Number of splicings carried out;
 - (c) Hammer weight and type;
 - (d) Drop of hammer;
 - (e) Penetration record for the full length of pile, for the number of piles selected by the SO;
 - (f) Final sets of the last 10 blows;
 - (g) Field record of temporary compression at final set stage;
 - (h) Actual length of pile from cut off level.
 - (iv) Large diameter bored pile
 - (a) Excavation record for the full length of pile (including classification of each type of soil encountered and the depth at which encountered);
 - (b) Length of pile;
 - (c) Slump of concrete;
 - (d) Graphical plot for theoretical and actual volume of concrete cast against concrete top level, particularly at withdrawal of casing segments;
 - (e) Method of compacting concrete;
 - (f) Casting time on completion of each pile.
 - (v) Minipile/
Rock-socketed
Steel H pile
 - (a) Pile reference number
 - (b) Date and time of boring
 - (c) Soil samples taken and in-situ test carried out if any
 - (d) Date pile installed
 - (e) Pile type and size, including diameter and number of reinforcement bars and internal size of casing
 - (f) Date and time of drilling
 - (g) Date of grouting
 - (h) Position of pile in the works and ground level at pile position
 - (i) Working level
 - (j) Drilling rates, compressed air pressure and material encountered
 - (k) Samples of rock cutting flushing in the rock socket

- (l) Depth from working level to pile toe
- (m) Toe level
- (n) Depth from working level to pile head level
- (o) Depth and level of top of rock socket
- (p) Length and toe level of casing
- (q) Length of reinforcement for Minipile; or length of steel H-pile for RSSHP
- (r) Grout mix
- (s) Volume of grout in pile (actual and theoretical)
- (t) Details of obstructions, delays and other interruptions to sequence of work
- (u) Flow rate and total time required for the grouting operation
- (v) Grouting pressure used
- (w) Contours of rockhead inferred from drill hole logs

Loading tests 5.29

- (i) The SO may order 1% of nos. of piles installed (minimum one number or more piles), other than large diameter bored piles, to be load tested to twice the allowable load capacity (for both vertical piles and raking piles). Loading tests of piles shall be carried out by a Testing Firm employed direct by the Employer. The Contractor shall co-ordinate the works with the Testing Firm and comply with the following requirements:

- (a) Preparation of Test Piles

The Contractor shall:

- (i) Expose and prepare pile heads such that the pile heads are level, clean and free from soil and debris and able to accommodate the testing equipment on the pile heads.
- (ii) If required by the SO, extend the test piles to a suitable level.
- (iii) Design and construct a suitable pile cap to the test pile.

- (b) Attendance to be provided by the Contractor

The Contractor shall, in addition to those items listed in Clause 1.42, provide the following attendance to facilitate the testing of piles by the Testing Firm:

- (i) Provide access to the test piles.
- (ii) Provide and erect kentledge with adequate stability and safety and approved by the SO for the loading tests. The weight of the kentledge shall be at least 1.15 times the maximum test load and shall be placed such that the load centroid matches the centre of the test pile.

- (iii) Install any fixtures as required by the Testing Firm, necessary for the carrying out of the loading tests and protect the same against weather.
- (iv) Provide electricity and lighting 24 hours a day for the pile loading tests.
- (v) Witness the testing process throughout the testing period.
- (vi) Provide a weather protected room for accommodating the equipment and instruments used by the Testing Firm.

The Testing Firm will be responsible for providing the reference frames, all measuring equipment and for surveying the movement of the reference frames. It will also provide 24-hour security throughout the duration of the loading test.

(c) Loading Test Failures

Should any pile tested fail to comply with the Contract requirements, the Contractor shall bear all the costs arising from the testing of additional piles.

- (ii) The test load shall be applied in 2 equal increments up to the allowable load capacity of pile, then released and reapplied in 4 equal increments up to the maximum test load and maintained for at least 72 hours before removal. The load at each incremental stage shall be held for a period of 10 minutes or longer until the rate of settlement is less than 0.05 mm in 10 minutes.
- (iii) Recovery after the removal of the maximum test load is deemed to have ceased when the rate of recovery is less than 0.1 mm/hour observed in a period of not less than 15 minutes.
- (iv) A total settlement or residual settlement in excess of that calculated from the formulae below shall be deemed to be failure to satisfy the settlement criterion in the loading test.

Total
Settlement = $d + D/120 + 4 \text{ mm}$

Residual
settlement = $D/120 + 4 \text{ mm}$; and 25% of the maximum pile head settlement during the test, whichever is the greater.

where:

d = PL/AE

D = Diameter of circular pile in mm, or
 = The least lateral dimension of steel 'H' pile section in mm (for driven steel 'H' pile)
 = Outer diameter of steel casing for Minipile, or
 = Diagonal of rectangle enclosing H-section for RSSHP)

P = Test load

L = Nett length of pile (For piles with rock sockets, L shall be measured to the centre of the rock socket.)

A = Cross sectional area of pile, or
 = Transformed section comprising casing, grouting and rebars for Minipile, or
 = Cross sectional area of steel 'H' pile for RSSHP

E = Young's modulus of pile given below:

	<u>Young's modulus</u> (MPa)
<u>Concrete or same strength of grout</u>	
Grade 20	18,700
25	20,500
30	22,200
78.58	33,900
<u>Steel piles</u>	205,000

In calculating the elastic compression/extension of the test pile for RSSHP, the following shall be considered:-

- (a) The contribution from cement grout within the length of the rock socket.
- (b) The contribution from the casing if it cannot be extracted for whatever reasons.
- (v) Complete preparatory works for the loading test not later than 28 days from the date the instruction to test is received.
- (vi) Make good the test pile after completion of the test including breaking up and clearing away any temporary pile cap and backfilling the pit in accordance with Clause 5.27.

Coring tests 5.30

- (i) The SO may order one or more coring tests to be carried out to any number of large diameter bored piles.
- (ii) 5% of the total number of large diameter bored piles shall be subject to continuous cores through the concrete shaft and carried down to a distance of at least half a diameter of the pile base, or 600 mm, whichever is larger, into bedrock with a diamond bit and double barrels and subsequently pressure grouting the drill holes with cement and sand (1:3) grout. The diameter of the cores to be as follows:
 - (a) 100 mm (minimum) where the maximum size of aggregate in the concrete shaft does not exceed 25 mm.
 - (b) 150 mm (minimum) where the maximum size of aggregate in the concrete shaft exceeds 25 mm and does not exceed 40 mm.

For toe coring, refer to Clause 5.30.1.

- (iii) Arrange cores recovered in core boxes in proper sequence. Deliver sample sections of cores to the Public Works Laboratories (PWL) for testing. When honeycombing or incomplete recovery of cores at any location along the full length of cores occurs, the pile shall

be deemed to have failed the coring test. Honeycombing shall mean interconnected voids arising from, for example, inadequate compaction or lack of mortar.

- (iv) Should the estimated in-situ cube strength of any sample section of core be less than 85% of the design grade strength, the pile shall be deemed to have failed the coring test. The estimated in-situ cube strength shall be assessed in accordance with **CS1**.

Toe Coring	5.30.1	Toe coring to obtain a core of N size to examine the interface between pile and bedrock without coring through the entire length of pile shall be carried out. One number of toe coring shall be carried out for each barrette and large diameter bored pile with diameter up to 2500 mm and two numbers of toe coring shall be carried out for each large diameter bored pile with diameter exceeding 2500 mm. The toe coring length shall be more than 1400 mm of which at least 700 mm shall be into bedrock. Refer to Clause 5.30 for testing and acceptance.
Failure of loading test or coring test	5.31	<p>When a pile fails a loading or coring test, install additional pile(s) such that the revised piling layout is sufficient to sustain the loadings as given in the loading schedule. For driven steel H-piles, the Contractor may choose to retain the pile as a working pile and redrive it to a deeper level to attain a bearing capacity complying with the contract requirements. However, DPT and CAPWAP analysis shall be carried out to test the pile for integrity and determine pile capacity. The cost of DPT and CAPWAP analysis shall be borne by the Contractor. The SO may carry out other test(s) as he deems appropriate.</p> <p>Carry out test probes if required to position additional piles. Design extended or extra pile caps and strap beams and any other work necessitated by the pile failure and obtain the agreement of the SO in writing.</p>
Inspection of piles	5.32	The SO may direct that piles be exposed for inspection.
Non-destructive integrity testing	5.33	<p>Non-destructive integrity tests shall be carried out by a Testing Firm appointed by the Employer. The Contractor shall, in addition to those items listed in Clause 1.42, provide attendance and other preparatory works as required.</p> <p>The Contractor shall notify the SO 5 working days in advance for carrying out the non-destructive integrity tests of piles on site.</p>
Number of tests required for non-destructive testing	5.34	Unless otherwise specified, the number of piles to be tested is as indicated in Annex 'F'.
Preparation of piles for non-destructive integrity testing generally	5.35	<p>Preparation of piles for non-destructive integrity testing generally:</p> <ul style="list-style-type: none"> (i) The type and extent of preparation work and attendance required for non-destructive integrity testing depends on the type of pile used in the contract. (ii) Co-ordinate with the Testing Firm to facilitate the testing of piles. (iii) Provide the Testing Firm access to the test pile and witness the testing process throughout the testing period. (iv) Provide the Testing Firm with a copy of the ground investigation report, a Site plan showing bore hole locations and pile layout and a

list of the piles to be tested with the date of concreting, total length, length of casing (if any), diameter and volume of concrete used plus any other relevant information required for the testing of the pile.

**Preparation for
piles for
Sonic Logging** **5.36**

Prepare piles for Sonic Logging

- (i) Place in all large diameter bored piles, barrettes and diaphragm wall panels, tubes of mild steel not less than 42 mm internal diameter which shall be regular and free from defects, so as to permit the free and unobstructed passage of the testing probes. Tubes shall be watertight, free from corrosion with clean internal and external faces.
- (ii) The tubes shall be fitted with a screw-on steel watertight shoe and shall be securely fixed to the interior of the reinforcement cage or fixed by other methods approved by the SO. The tubes shall be parallel to each other and to the axis of the pile. Where sections of tubing are required to be spliced, joints shall be made watertight.
- (iii) The tubes shall be plugged or capped before concreting. The tubes shall extend the full depth of the pile, barrette or diaphragm wall panel, and stop at about 300 mm above the top of the concrete cast.
- (iv) Install tubes in the number tabulated below and at spaces as directed by the SO:

(a)	Large diameter bored piles, 700 - 900 mm diameter	- 3 No./pile
(b)	Large diameter bored piles, exceeding 900 mm diameter	- 4 No./pile
(c)	Barrettes up to 3.0 m long	- 4 No./barrette
(d)	Barrettes over 3.0 m long and diaphragm wall panels	- Sets of 2 No. at 3.0 m centres/barrette or diaphragm wall panel
- (v) Before testing, fill up the tube with water to provide the necessary acoustic coupling and refill with water prior to testing as necessary. A plan shall be provided to the Testing Firm showing the layout and the constructed length of the structural elements to be tested.
- (vi) All tubes shall be cut off flush with the concrete and filled up by pressure grouting with cement and sand (1:3) grout at completion of all testing.
- (vii) Notwithstanding Clause 5.36 (i), for barrettes and large diameter bored piles with diameter up to 2500 mm, one of the mild steel tubes shall be replaced with a larger tube of 100 to 150 mm internal diameter. For large diameter bored piles exceeding 2500 mm diameter, two numbers of the mild steel tubes shall be replaced with a larger tube of 100 to 150 mm internal diameter. Size of tube shall be big enough to obtain a core of N size. The bottom of the larger steel tube should be fitted with a mild steel cap, at about 700 mm above the founding level of the pile.

**Preparation of
piles for
Integrity Testing** **5.37**

Prepare piles for Integrity Testing

(i) Pile head surface

Cut off the piles to the required level and trim off reinforcement bars if necessary and make good as directed by the SO. Provide a level and smooth surface for the motion sensor attachment at impact locations as advised by the Testing Firm

(ii) For cast in-situ piles

(a) No cast in-situ concrete pile shall be tested until at least 7 days after construction.

(b) The pile head shall be free of debris and the like, and shall not be more than 1 metre above or below adjacent ground level. All weak mortar, broken concrete and the like, shall be removed from the pile head to expose sound concrete, and the head made horizontal over its complete cross-section.

(iii) For precast prestressed tubular piles

Testing may be performed on the steel plate of the original pile head. In such case, prepare the pile such that the pile head and the screw holes are clearly exposed, dry and free from soil and debris.

(iv) Inspection

Before testing, the heads of the piles shall be inspected by the Testing Firm for regularity and soundness.

**Preparation of
piles for Dynamic
Testing** **5.38**

Prepare piles for Dynamic Testing:

(i) Testing may be performed during piling construction (installation testing) or at some time after construction (restrike testing). Provide the following equipment and work for carrying out the tests.

(a) Access to the test pile.

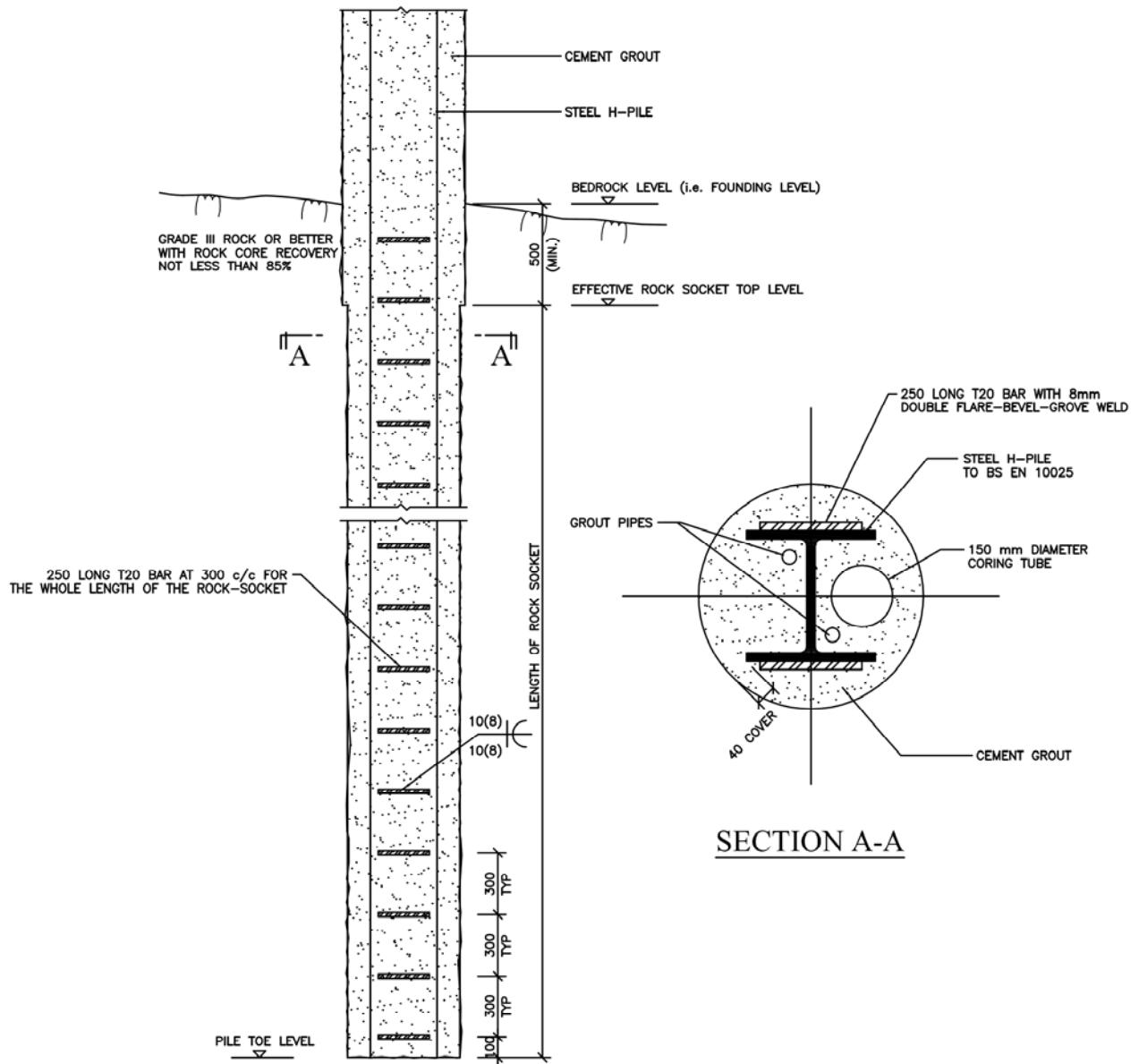
(b) Driving equipment for piles selected for pile driving analysis and driving the piles.

(c) Extension to the test piles to a level as and when required for the dynamic testing.

(d) Welders and welding facilities when required.

(e) Electric power supply at the test pile location.

(f) Final set record measurement during the test.



TYPICAL SHEAR BARS DETAILS FOR ROCK-SOCKETED STEEL H-PILE

ANNEX E

Number of Piles requiring Non-Destructive Integrity Test

Type of pile Tests	Large Diameter Bored Piles & Barrettes	Steel H-piles, Precast Concrete Piles, Precast Prestressed Tubular Piles	Non-Percussion Cast in-situ Concrete Piles
Pile Integrity Test	-	-	15%
Dynamic Pile Test	-	Not less than 30 nos. or 15% whichever is the greater	-
CAPWAP Analysis	-	5%	-
Sonic Logging	All piles	-	-

ANNEX F

Amendments to Section 6

- | | | |
|-----------------------|-------------|---|
| Test specimens | 6.17 | <ul style="list-style-type: none"> (i) Provide and cut test specimens from each batch of steel reinforcement as directed by the SO. All test specimens shall be appropriately marked and delivered to the Public Works Laboratories (PWL) for testing. No claim in respect of steel suffering from damage or rod lengths being reduced due to the taking of testing specimens will be entertained. (ii) Alternatively the Contractor may deliver test specimens to the independent laboratories approved by the SO. (iii) Test certificates shall be sent to the SO directly from these independent laboratories. (iv) Allow sufficient time for the testing of specimens. Do not use steel reinforcement until the relevant test specimens have successfully passed all tests. Remove unsatisfactory material off the Site when instructed by the SO. (v) For steel reinforcing bars, determination of mass per metre, tensile test, rebend test, chemical analysis and test on bond property based on surface geometry shall be carried out on test specimens for each batch of steel reinforcing bars delivered to site in accordance with CS2. (vi) For fabric reinforcement, provide one sample from each batch for testing. The size of each batch shall not exceed 50 tonnes. |
|-----------------------|-------------|---|

(vii) Each sample shall comprise three 1.2 m long x 1.2 m wide test specimens taken from different sheets in the batch. Each test specimen shall contain at least three wires in each direction.

(viii) The method of testing shall be in accordance with the following:

Cold reduced steel wire : BS 4482
Steel fabric : BS 4483

(ix) The number of tests on each sample of fabric reinforcement shall be as follows:

Description	Type and number of tests				
	Tensile	Rebend	Unit Mass	Weld Shear Stress	Pitch Dimension
Steel fabric					
- fabric sheet	-	-	2 ^(a)	2	-
- longitudinal wire	3	1	-	-	1
- transverse wire	3	1	-	-	1
^(a) One sample for the longitudinal direction and one for the transverse direction					

(x) If the result of any test for yield stress, tensile strength, elongation, weld shear strength, rebend, unit mass or pitch dimension does not comply with the specified requirements for the property, two additional test specimens shall be provided from different reinforcement of the same batch and additional tests for the property shall be carried out.

(xi) The batch of fabric reinforcement is considered as not complying with the specified requirements for any particular property if the result of any additional test does not comply with the specified requirements for that property. The non-complying batch of fabric reinforcement shall be removed from the Site.

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 EN1008** when required by the SO.

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

- (i) The density of the combined water comprising tap water and recycled water does not exceed 1030 kg/m³.
- (ii) The 28 days strength of test cubes with combined water shall not fall below 90% of control test cubes made with tap water.
- (iii) The chemical limits of the combined water shall not exceed those in Table 6.12.
- (iv) Tests shall be conducted in accordance with Table 6.12.

Generally

6.40

Designed mix concrete shall be designated by the grade strength in MPa followed by the nominal maximum size of aggregate in mm with suffix "D".

Standard mix concrete shall be designated by the grade strength in MPa followed by the nominal maximum size of aggregate in mm with suffix "S".

Grade strength is the compressive strength of the concrete stated in the contract. Compliance with the grade strength shall be ascertained in accordance with Clause 6.55.

The cementitious content of any mix shall meet the requirements in Table 6.5 but shall not exceed 550 kg/m³ of compacted concrete.

The nominal designed slump value for designed mix for reinforced concrete shall not be less than 75 mm unless the contractor can demonstrate that proper compaction can be achieved with a lower slump which shall in no case be less than 50 mm. The free water cement ratio shall comply with Table 6.5 unless otherwise stated in the contract.

The quality and strength of concrete shall be determined by tests on samples taken on the Site and tested at the Public Works Laboratories (PWL) as directed by the SO.

Standard mixes 6.41

If it is not proposed to use designed mixes, the standard mix proportions shown in Tables 6.3 and 6.4 shall be used.

Compliance testing shall be in accordance with Clauses 6.55, 6.56 and 6.57. Notwithstanding the provisions of these clauses the SO may reduce the frequency of sampling and testing if he is satisfied with the Contractor's quality control.

Admixtures may be used subject to the provisions of Clause 6.36.

TABLE 6.3

Standard mix concrete
Mass of total aggregate to be used with 100 kg of PC
or 110 kg of PFAC

Grade strength (MPa)	Nominal maximum aggregate size (mm)	40	20	10
	Range of measured slump value (mm)	85 - 170	75 - 150	65 - 130
10	Mass of total aggregate (kg)	800	690	-
20		550	500	400
25		490	440	360
30		440	380	300

TABLE 6.4

Percentage by mass of fine aggregate to total aggregate
for standard mix concrete

Grade strength (MPa)	Grading of the aggregate	Nominal maximum aggregate size (mm)	40	20	10
10	C, M or F	Percentage by mass of fine aggregate to total aggregate (%)	30 - 45	35 - 50	-
20, 25 or 30	C		30 - 40	35 - 45	45 - 55
	M		25 - 35	30 - 40	40 - 50
	F		25 - 30	25 - 35	35 - 45

Note : Grading C, M and F refer to those given in **CS3**

Designed mixes 6.42 Design the concrete mix to fulfill the minimum cementitious content and maximum free water cement ratio requirements shown in Table 6.5 unless otherwise specified in the contract.

The designed concrete mix shall have a mean strength greater than the required grade strength by a margin sufficient to ensure compliance with Clause 6.55.

20% recycled coarse aggregates 6.42.3 When specified, concrete with 20% recycled coarse aggregates shall be used in designed mix concrete of 25 to 35 MPa grade strength except in water retaining structures, subject to the following :

- (i) Either Type CEM I of Portland cement to **BS EN 197-1** or Type CEM I Portland cement in combination with PFA can be used in accordance with Clause 6.30.
- (ii) Coarse aggregates shall consist of 80% natural rock aggregates as defined in the GS and 20% recycled coarse aggregates.
- (iii) Recycled coarse aggregates shall be produced by crushing old concrete and shall meet the requirements in Table 6.13.
- (iv) Tests on recycled aggregates from a particular source, with the exception of Government sources, shall be carried out by the aggregates producer at weekly intervals in compliance with Table 6.13.
- (v) Fine aggregates shall be as defined in the GS.
- (vi) Fine aggregates recycled from old concrete shall not be used.
- (vii) The grading of the coarse aggregates shall comply with the limits as defined in the GS for single-sized 20 mm and 10 mm aggregates.
- (viii) Recycled coarse aggregates shall be thoroughly wetted before being used.

- (ix) The concrete shall have a minimum slump of 75 mm when it is ready to be compacted to its final position.
- (x) Before any concrete is produced for use in the works, trial mixes shall be performed in accordance with the GS.
- (xi) Compliance criteria in cube strength shall be as defined in the GS.
- (xii) Recycled aggregates shall be stored in separate stockpiles or silos to prevent inadvertent mixing with natural aggregates.
- (xiii) A separate compartment shall be provided for recycled aggregates in the batching plant.
- (xiv) Natural aggregates shall be used in lieu of the recycled aggregates in case of supply shortage of recycled aggregates.

TABLE 6.5

Minimum cementitious content (kg/m³) and
maximum free water cement (W/C) ratio

Exposure conditions	Maximum aggregate size (mm)	Plain concrete		Reinforced concrete and prestressed concrete	
		Minimum cementitious content	Maximum free W/C ratio	Minimum cementitious content	Maximum free W/C ratio
Moderate	40	245	0.65	300	0.60
	20	275		300	
	10	315		340	
Severe	40	270	0.60	300	0.55
	20	300		325	
	10	340		365	

Where the exposure condition of a structure is not specified, all concrete shall be deemed to be exposed to moderate condition.

Approved concrete mix

6.43.5

When the mix has been approved, do not make variations in the proportions and sources of materials or in the type, size and grading of aggregates without the consent of the SO, who may require further trial mixes to be made.

Notwithstanding the above, the cementitious content of the approved concrete mix may be varied during routine production by an amount not exceeding 20 kg/m³, provided that the specified limits for cementitious content are maintained.

The SO may also require practical tests to be made on the Site by filling trial moulds or by pumping to confirm the suitability of the mix for the Works. In such tests, the type of plant used for mixing, transporting and placing, the method of compaction used, the formwork face to the mould and the size and disposition of reinforcement shall be similar in all respects to those intended for use in the Works.

Chloride content 6.45

The total chloride content of the concrete shall not exceed the limits shown in Table 6.6 expressed as a percentage relationship between chloride ion and mass of cementitious material in the mix.

TABLE 6.6

Chloride content

Type of concrete	Maximum total chloride content %
Prestressed concrete Steam cured structural concrete	0.1
Reinforced concrete made with sulphate resisting Portland cement	0.2
Reinforced concrete Concrete with embedded metal	0.35

Workability 6.46

Adopt a free water/cement ratio complying with Table 6.5 to produce concrete of adequate workability with the aid of admixtures as necessary. Check the workability by using slump or flow table tests to **CS1**. A guide to the degree of workability required for various types of work is shown in Table 6.7.

Concrete mix with a nominal slump less than 75 mm shall not be used unless the Contractor can demonstrate that proper compaction can be achieved with a lower slump which shall in no case be less than 50 mm.

TABLE 6.7

Workability

Degree of workability	20 mm maximum size aggregate		40 mm maximum size aggregate		Uses of which concrete is suitable
	Slump (mm)	Flow (mm)	Slump (mm)	Flow (mm)	
Low	50		50 – 75		Simply reinforced large sections, concreting with vibration
Medium	75 - 100		100 – 150		Moderately reinforced sections such as ordinary beams and slabs, concreting with vibration
High	100 - 150		125 – 175		Sections with congested reinforcement where vibration is difficult.
Very high	150-200	340-600			Sections with very congested reinforcement where vibration is very difficult.

Sampling of fresh concrete 6.54

Carry out sampling of concrete in accordance with the requirements given in **CS1**. Take each sample from a single batch. The location of batches to be sampled shall be decided by the SO, and the frequency of sampling for compressive strength testing and workability testing shall be as set out in Table 6.11, provided that a minimum of one sample shall be taken from each grade of concrete produced on any one day. The SO may agree to a reduced frequency of sampling for exceptionally large pours. The samples shall be taken at random times.

TABLE 6.8

Sampling rates

Type of structure	Approximate quantity of concrete to be represented by each sample
Critical structures	10 m ³ or 10 batches whichever is the smaller volume.
Intermediate structures	25 m ³ or 25 batches whichever is the smaller volume.
Massive concrete construction	100 m ³ or 100 batches whichever is the smaller volume.

Where the type of structure is not specified, all concrete shall be deemed to be for intermediate structures.

Concrete cubes 6.55

For compressive strength testing, make, cure and test concrete cubes in accordance with **CS1**. The size of test cubes shall be 100 mm for concrete with maximum aggregate size not exceeding 20 mm and shall be 150 mm for maximum aggregate size exceeding 20 mm.

- (i) Standard mixes
 - (a) Where a batch shall be sampled for the purpose of determining the strength of the concrete, make two cubes from a sample for test at 28 days.
 - (b) The strength requirement for each pair of cubes shall be satisfied if neither of the strengths of the cubes is below the strength indicated by the grade of concrete. If the strength requirement is not satisfied, the SO may order such further testing, including chemical analysis of samples of hardened concrete in the structure, as he considers necessary.
- (ii) Designed mixes
 - (a) Make two cubes from a single sample taken from a batch of concrete selected at random. Take the sample at the point of discharge from the mixer, or, in the case of ready-mixed concrete, at the point of discharge from the delivery vehicle, or elsewhere as directed by the SO. On completion of curing for 28 days, test the two cubes. The average of the two results shall be taken as the test result.
 - (b) The strength requirement shall be satisfied if the average strength determined from any group of four consecutive test results, and the individual test results comply with the strength determined from limits given in Columns A and B of Table 6.12 respectively. Where there are less than four test results available the average of the first two or first three consecutive test results shall be treated in the same manner as groups of four consecutive test results.
 - (c) If the difference between the compressive strengths of two test cubes made from one sample of designed mix concrete exceeds 15% of the test result:
 - (1) the higher of the compressive strengths of the two test cubes shall be used to assess compliance in Column B of Table 6.12, and
 - (2) the test result for that sample shall not be used to assess compliance in Column A of Table 6.12 and shall not be used to calculate the standard deviation.

TABLE 6.9

Strength compliance requirements for designed mixes

Specified grade	Compliance requirement	Column A Average of any 4 consecutive test results shall exceed the specified grade strength by at least		Column B Any individual test result shall not be less than the specified grade strength by more than	
		100 mm Cube	150 mm Cube	100 mm Cube	150 mm Cube
20 D and above	C1	7 MPa	5 MPa	2 MPa	3 MPa
	C2	5 MPa	3 MPa	2 MPa	3 MPa
Below 20 D	C3	3 MPa	2 MPa	2 MPa	2 MPa

- (iii) For concrete of grade 20D and above, calculate the standard deviation for each grade of concrete after every 40 test results. Compliance requirement C2 of Table 6.12 may be adopted under the following conditions :
- (a) Where there is sufficient previous production data using similar materials from the same plant under similar supervision to establish that the standard deviation of at least 40 test results is less than 5.5 MPa for 100 mm test cubes or 5 MPa for 150 mm test cubes; or
 - (b) Where the calculated standard deviation of a set of 40 consecutive test results does not exceed 5.5 MPa for 100 mm test cubes or 5 MPa for 150 mm test cubes.
- (iv) If the calculated standard deviation exceeds 5.5 MPa for 100 mm test cubes or exceeds 5 MPa 8 MPa for 150 mm test cubes, compliance requirement C1 shall apply to subsequent test results.
- (v) When the following situation occurs, no further concrete shall be placed in the permanent works until an investigation of the materials, mix design, methods of production, sampling and testing has been carried out and measures, which in the opinion of the SO will result in restoring a satisfactory standard of quality control, have been taken: -
- (a) For concrete of grade 20D and not exceeding grade 60D, the calculated standard deviation exceeds 8.5 MPa for 100 mm test cubes or 8 MPa for 150 mm test cubes; or
 - (b) For concrete grade exceeding 60D, the coefficient of variation as calculated after every 40 test results, exceeds 14%.
- (vi) If the compliance requirements are changed from C1 to C2 or from C2 to C1, the new compliance requirements shall apply from the 35th day after making the last pair of test cubes in the set of 40 on which

the decision to change was based. For the purpose of calculating the average of any 4 consecutive test results, test results immediately before and immediately after the change shall be treated separately.

- (vii) For concrete of grade below 20D, adopt compliance requirement C3 of Table 6.12.
- (viii) If the average strength determined from any group of four consecutive test results, or the first two or first three consecutive test results if applicable, fails to meet the requirement of Column A in Table 6.12, then all the concrete in all the batches represented by the samples shall be deemed not to comply with the strength requirements. For the purposes of this clause the batches of concrete represented by a group of two, three or four consecutive test results shall include the batches from which the first and last samples in the group were taken together with all the intervening batches. Provided that when there is a period exceeding two weeks between any two consecutive test results in a group, the SO may direct that the test results immediately before and immediately after the intervening period shall be treated separately.
- (ix) If any individual test result fails to meet the requirement of Column B in Table 6.12, then that result may be considered to represent only the particular batch of concrete from which the sample was taken, provided that the averages of any 4 consecutive results, in which the failed individual test result lies, satisfy the requirements of Column A in Table 6.12.
- (x) If designed mix concrete is considered as not complying with the specified requirements for compressive strength, the SO may instruct that tests as stated in Clauses 6.57 and 6.59 be carried out on concrete cores or on samples taken from the hardened concrete.

Workability 6.56

Where a batch shall be sampled to determine the workability of the concrete, take samples in accordance with **CS1**. In all cases the sample shall be re-mixed, divided into two specimens and each specimen tested for slump or flow value in accordance with **CS1**. Unless otherwise specified, adopt the testing method for workability as below:

Normal Workability (designed slump value from 20 mm to 175 mm)	High Workability (designed flow value from 340 mm to 600 mm)
Slump Test	Flow Table Test

- (i) Standard mixes:

The average of the two measured slump values shall be within the appropriate range of measured slump value specified in Table 6.3. The SO may reject any concrete for which the average measured slump falls outside the specified range.

- (ii) Designed mixes:

The average of the two measured slump values shall correspond to that of the accepted trial mix and fall within the limit of ± 25 mm or $\pm 33\%$ of the designed slump value, whichever is the greater. The average of the two measured flow values shall correspond to that of the accepted trial mix and fall within the limit of ± 50 mm of the

designed flow value. The SO may reject any concrete for which the average measured slump or flow value falls outside this limit.

Concrete that fails to comply with the specified requirements for workability as specified in Clause 6.56(i) or 6.56(ii) shall not be placed in the permanent works.

Failures

6.60

If any part of the finished concrete fails to comply with the standards of acceptance specified in Clauses 6.55(i) to (ix), 6.57 or 6.59, the SO may instruct the Contractor to take any one of the following steps or a combination thereof as the SO considers appropriate:

- (i) Adjust the mix proportion and carry out further trial mixes until a new mix proportion satisfying the requirements of Clause 6.55 is obtained and approved. Standard mix proportions shown in Table 6.3 may be used during this period.
- (ii) Improve the standard of quality control.
- (iii) Carry out, at the Contractor's expense, other tests as directed by the SO.
- (iv) Replace any Site concrete condemned as a result of failing to comply with the standards of acceptance specified and meet all costs arising from such replacement. Submit for approval the method statement for replacing the condemned concrete before the replacement is carried out. In certain cases, the SO may require the method statement to be prepared and the remedial work to be supervised by a Registered Structural Engineer.

Workmanship

6.62

Construct joints strictly as specified and in accordance with the relevant manufacturer's recommendations. Keep edges true, free from cracks, spalling or other imperfections. Ensure that edges of joints are clean, dry and free from dust or grease.

Do not place concrete on both sides of a movement joint simultaneously.

All water stops shall be installed in accordance with manufacturer's recommendation and be securely held in position. Make all joints properly, using hot or cold vulcanizing. Prevent edge-bulbs from moving during concreting. Special care shall be taken to compact concrete around water stops such that no voids or porous areas result.

Fix joint filler to the concrete with a bituminous adhesive before casting the adjoining bay. Form a sealing slot by casting in a removable former.

Apply sealants in accordance with **BS 6213**. Ensure that they are properly pressed home and finished with a smooth regular surface. Type and uses of sealant are shown in Table 6.13.

TABLE 6.10

Types of Sealant

Type of sealant	Application	General use	Specific use
Oil based mastic	Applied cold by gun	Weathersealing, low movement joints	Pointing frames
Butyl mastic	Applied cold by gun or trowel	Bedding	Bedding frames and glazing
Hot applied joint sealants (BS EN 14188-1 Type N1)	Hot poured	Horizontal and inclined joints where the degree of inclination does not exceed 1 in 20	Joints in concrete roads, car parks etc.
Cold poured joint sealants (BS EN 1488-2)	Two part compound mixed and applied cold by gun or poured	High movement joints, resistance to fuel, oil & hydraulic fluid	Ditto but where resistance to fuel & oil is required
Two part polysulphide (BS EN ISO 11600+A1)	Ditto	High movement joints, resistance to aging & damage, acids & alkalis	Joints in walls & floors. Sealing to precast units
One part polysulphide (BS EN ISO 11600+A1)	Applied cold by gun	Ditto	Joints in cladding panels pointing aluminium windows glazing
One part polyurethane	Applied cold by gun	Ditto	Ditto

Treat surfaces with recommended primer to suit type of sealant where necessary.

Apply bond breakers and back up material where necessary.

Mix two - part sealants until the colour is uniform throughout.

Lintels**6.68**

Cast lintels in concrete Grade 20/20 either precast or cast in-situ, and construct as shown in Table 6.11.

Provide 25 mm minimum concrete cover between steel bar reinforcement and soffit.

Allow bearing of 150 mm (minimum) at each end.

TABLE 6.11

Lintels

Clear span (m)	Depth of lintel (mm)	No. and diameter of steel reinforcing bars per 105 mm (or part) in width
0 - 1	150	One 12 mm
1 - 2	225	One 16 mm
2 - 3	300	One 20 mm

TABLE 6.12

Chemical Limits for Combined Water (Recycled water and tap water) for each batching plant

Description	Limits	Test method	Test frequency
Physical test			
(a) Density test for recycled water	$\leq 1030 \text{ kg/m}^3$	Note 1	At least once per day
(b) Initial setting time of cement with recycled water (time of set, deviation from control, h:min)	From 1:00 earlier to 1:30 later	BS EN 196-3	Once every 3 months for the first year and thereafter at half-yearly intervals
Chemical test for recycled water			For all tests:
(a) Chloride content (as Cl^-): - prestressed concrete steam-cured structural concrete	500 ppm	APHA 4500-Cl D	(i) Once per week for the first 2 months
- concrete with reinforcement or other embedded metal	1,000 ppm	APHA 4500-Cl D	(ii) Once per month for the next 12 months thereafter
(b) Sulphate content (as SO_4)	3,000 ppm	APHA 4500-SO42 C	(iii) In case of a weekly or monthly test indicates that the limits are exceeded, the water shall immediately be suspended for use in concrete mixing until two sets of consecutive test results taken from the same source are satisfactory. In such case, the testing frequency shall be maintained at or reverted back to once per week until two sets of consecutive test results are satisfactory.
(c) Acid-soluble alkali content	600 ppm	BS EN 1008	(iv) The testing frequency shall be subject to review after the 12-month period for the monthly test.

- Notes:
1. Test method to be proposed by the Contractor for the acceptance of the SO.
 2. Accredited Laboratory for the relevant tests shall be used, if available, in which case results shall be issued on HOKLAS endorsed test reports.
 3. Where ppm means part per million by mass

TABLE 6.13

Recycled coarse aggregate

Mandatory Requirements	Limits	Testing Method
Minimum dry particle density (kg/m ³)	2000	Section 17 of CS3
Maximum water absorption	10%	Section 17 of CS3
Maximum content of wood and other materials less dense than water	0.5%	Manual sorting in accordance with: BRE Digest 433
Maximum content of other foreign materials (e.g. metals, plastics, clay lumps, asphalt and tar, glass etc.)	1%	
Maximum content of fines	4%	Section 10 of CS3
Maximum content of sulphate (% m/m)	1%	Section 21 of CS3
Flakiness index	40%	Section 11 of CS3
10% fines test	100 kN	Section 16 of CS3
Grading	Table 3.1 of CS3	
Maximum chloride content	Table 5.1 of CS3 – 0.05% by mass of acid soluble chloride ion of combined aggregates	

Amendments to Section 8

Prescribed mix concrete with 100% recycled coarse aggregates **8.22**

When specified, concrete with 100% recycled coarse aggregates shall be applicable to prescribed mix concrete of 20 MPa grade strength and shall be used only in benches, stools, planter walls, concrete mass walls and other minor concrete structures, in compliance with Section 8 and subject to the followings which shall take precedence in case of discrepancies:

- (a) Recycled coarse aggregates shall be produced by crushing old concrete and shall meet the requirements in Table 6.13.
- (b) Fine aggregates shall be as defined in the GS.
- (c) Fine aggregates recycled from old concrete shall not be used.
- (d) The grading of the coarse aggregates shall comply with the limits as defined in the GS for single-sized 20 mm and 10 mm aggregates.
- (e) Concrete shall be mixed in the following proportions:

Portland Cement	:	100 kg
Fine Aggregate	:	180 kg
20 mm Coarse Aggregate	:	180 kg
10 mm Coarse Aggregate	:	90 kg
- (f) Recycled coarse aggregates shall be thoroughly wetted before being used.

- (g) The concrete shall have a minimum slump of 75 mm when it is ready to be compacted to its final position.
- (h) 4 concrete cubes shall be made on each concreting day, 2 for crushing tests at 7 days and the other 2 for crushing tests at 28 days. The minimum concrete cube strength shall be 14 MPa and 20 MPa at 7 and 28 days respectively.
- (i) Before any concrete is produced for use in the works, trial mixes shall be performed in accordance with the GS. The 28 day strength of each of the 3 cubes in the trial shall not be less than 26 MPa.
- (j) Natural aggregates shall be used in lieu of the recycled aggregates in case of supply shortage of recycled aggregates.

Amendments to Section 9

Generally	9.01	Brickwork and blockwork to be in accordance with PD6697:2010, BS EN 1996-1-2, BS EN 1996-2, BS EN 1996-3.
Facing bricks	9.03	<p>Facing bricks to have the following properties in accordance with ASTM C216-16:</p> <ol style="list-style-type: none"> 1. 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; 2. Saturation coefficient cannot exceed 0.78; 3. 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; 4. The faces shall be free of cracks or imperfections when viewed from a distance of 6 meters.
Proportion	9.22	<p>Mix constituents to the following proportions:</p> <ol style="list-style-type: none"> (a) Cement mortar cement and sand 1:3. (b) Cement/lime mortar cement, lime putty and sand 1:1:6 for external walls and 1:2:9 for internal walls. (c) Firebrick mortar to be: <ol style="list-style-type: none"> (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. <p>Proportions given are for dry sand. Allow for bulking.</p> <p>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.</p>
Samples of face brickwork and blockwork	9.26	Prepare sample panels of approximately 1 m ² of faced brickwork and fair faced brickwork or blockwork, including pointing, and obtain approval before proceeding.

Finishing of joints 9.39 Strike off joints not visible in the finished work as the work proceeds. Fill joints in fair faced work as the work proceeds to provide a smooth surface flush with the brick or block face or with details as approved.

Finish joints in faced brickwork with either a trowelled weathered joint as the work proceeds, or rake out to a depth of 10 mm as the work proceeds and point with a weathered joint on completion. Rake out joints to a depth of 10 mm in brickwork to provide key for plaster or other wet applied finishes.

Amendments to Section 10

Wall ties 10.06 Ties between walls and concrete shall be 20 x 3 mm stainless steel flats 350 mm long, ganged 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 flats 150 mm long, fanged at both ends and shall be to **BS EN 845-1+A1**.”

Pointing ashlar walling 10.20 Joints in ashlar walling shall be raked to a depth of 15 mm as the works proceeds and shall be finished with a weathered or recessed joint as specified on completion using bedding mortar.

Amendments to Section 12

Generally 12.99 Proprietary roofing systems shall be laid by specialist contractors approved by the manufacturers/agents.

Warranty 12.119 Duly executed warranty shall be submitted in accordance with the Contract. The completed installation shall be guaranteed against defects of materials and workmanship for a period of 10 years from the date of completion stated in the certificate of completion with respect to the Works for use in Hong Kong. The system shall be designed to withstand the conditions of the Hong Kong climate, which includes typhoons, monsoons and rainstorms. The warranty shall cover the roofing system in its entirety. The warranties shall be extended to cover all aspects of the roofing project executed including adhesion and structural integrity of materials used.

Amendments to Section 14

Standard 14.04 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 pivoting 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	Hot dip galvanized coatings on fabricated iron and steel articles specifications and test methods.
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 EN 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.

*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.

BS 476 Fire tests on building materials and structure.

BS 1449-1.1/1.8/ Steel plate, sheet and strip.

1.14

BS 3621 Thief resistant locks.

BS 5499-2,4,6 Safety signs, including fire safety signs.

& 10

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.

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

Certification for fire door	14.06	Individual independent fire test/assessment certificates to BS EN 1634 specific to each fire rated door assembly proposed for the Works shall be submitted to confirm compliance with required fire resistance ratings.
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Compatibility	14.10	Ironmongery shall be properly matched, fully coordinated suite, of consistent design and finish, and obtained from approved reputable source.
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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.
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Arrange with the SO for the safe storage and handling of keys and ensure their receipt by the SO on completion of the Contract. When master keying is specified, the master keys shall be forwarded direct to the SO.

Hinges and pivots	14.24	Hinges shall be countersunk drilled, fixed with matching screws and of the following types:
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For timber doors and frames:	Jig drilled, with staggered drilling pattern and 12 screw gauge (SG) x 32 mm wood screws
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For pressed steel doors and frames:	ANSI template drilled with M5 or M6 x 12.5 mm machine threaded screws
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For timber doors with steel frames:	Different drilling patterns for leaf and frame as appropriate to timber and metal substrate
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Overhead door closers	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 The Door and Hardware Federation (DHF), Code of Practice "Hardware for Timber 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.
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14.48

TABLE 14.1

BS EN 1154

1	2	3	4	5	6	7	8	9
<u>Door closer power size</u>	<u>Recommended door leaf width</u> <u>mm max.</u>	<u>Test door mass</u> <u>kg</u>	<u>Closing moment</u>			<u>Opening moment between 0° and 60°</u>	<u>Door closer efficiency between 0° and 4°</u>	
			<u>between 0° and 4°</u>		<u>between 88° and 92°</u>	<u>any other angle of opening</u>	<u>Nm max.</u>	
			<u>Nm min.</u>	<u>Nm max.</u>	<u>Nm max.</u>	<u>Nm min.</u>		
1	<750	<u>20</u>	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.								

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 8mm followers for noise reduction, closing efficiency, security and improved durability.

14.94

Ironmongery sundries hardware shall suit the location and function and match architectural ironmongery in quality, design and finish.

Amendments to Section 15

15.48

Consumables 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 recommendations.

Submit delivery notes of welding consumables to the SO. Maintain a log book for welding consumables on site which shall contain the date, types and quantities of welding consumables delivered on site, and the updated balance. Submit daily record to the SO on the names of welders engaged, welding joints under preparation, types and quantity of welding consumables used.

Acceptance of welds

15.58

Employ an Accredited Laboratory to carry out and interpret the inspection and testing of welds, and provide any necessary labour and attendance. Submit evidence proving that operators carrying out the inspection and testing have been trained and assessed for competence in the inspection and testing of welds. In addition, submit certificates of competence from a recognised authority for operators carrying out ultrasonic examination. Arrange for the Accredited Laboratory to submit a testing programme for the approval of the SO. Any welds that shall be rendered inaccessible by subsequent work shall be examined prior to the loss of access.

Visually inspect all welds in accordance with **BS EN ISO 17637**, and after visual inspection, carry out non-destructive testing in accordance with Table 15.6:

TABLE 15.6

Weld Type	Frequency of Non-destructive Testing
Full penetration butt welds with maximum thickness of the parent material exceeding and including 8mm.	100% ultrasonic examination and magnetic particle inspection
Full penetration butt welds with maximum thickness of the parent material not exceeding 8mm.	100% magnetic particle inspection
Partial penetration butt welds with depth of penetration exceeding and including 8mm.	100% ultrasonic examination and magnetic particle inspection
Partial penetration butt welds with depth of penetration not exceeding 8mm.	100% magnetic particle inspection
Fillet welds with leg length exceeding and including 10 mm	20% ultrasonic examination and magnetic particle inspection
Fillet welds with leg length not exceeding 10 mm	20% magnetic particle inspection
Secondary attachment welds, e.g. for fixing purlins, side rails	5% of attachments by magnetic particle inspection and ultrasonic examination if leg length exceeds and includes 10 mm

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.

Carry out surface flaw detection by magnetic particle inspection (MPI) in accordance with **BS EN ISO 17638**. If MPI is impractical, dye penetration inspection (DPI) may be used, subject to the approval of the SO, in accordance with **BS EN ISO 3452-1**.

Carry out ultrasonic examination in accordance with **BS EN ISO 17640** Level B. Make printout results available during ultrasonic examination on site at 3 specified locations per weld (such as at both ends and in the middle of the weld) and at positions in question.

The Accredited Laboratory shall submit 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 from the subsequent repair and re-test.

Unless approved otherwise by the SO, carry out all non-destructive testing not less than 16 hours from the time of completion of the weld to be inspected, or not less than 40 hours in case of butt welds thicker than 40 mm or any welds to S450J0 steel. Should test results indicate that welds are below the standard of acceptance, carry out at the Contractor's own expense approved remedial measures and further acceptance tests.

Amendments to Section 16

Ordinances, Regulations, Codes and standards	16.05	Comply with the documents contained in this Specification as defined in Index 3 , regarding Ordinances, Regulations, Code of Practices, Standards and PNAP 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.
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Contractor's design responsibility	16.06	The design and performance of the system is the responsibility of the Contractor. The Drawings and Specification define design intent and performance requirements, they do not purport to show the details of the system as relating to the performance requirements. The details show the overall sizes and the preferred profiles. The connections and interfacing with other areas are the responsibility of the Contractor.
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Responsibilities include, but shall not be limited to, the following:

- (i) Unless otherwise specified, the appearance of exposed elements, including width and depth, shall be consistent throughout the project.
- (ii) Unless otherwise specified, the overall thickness of each glass type, and the component thicknesses of each multiple layer glass type, shall be consistent throughout the project.
- (iii) Provide anchor adjustment capability for the full range of specified tolerances. This must include provision for the angularity of the anchorage mounting surface.
- (iv) Provide movable joints to accommodate the full range of manufacturing tolerances, field tolerances, thermal movements, floor sag, beam sag, and column settlement. This includes provision for imposed load deflection of the slab and inter-storey drift.
- (v) Provide corrosion protection between dissimilar materials. The material used must be impervious to moisture whether or not it is installed in a designated dry area.
- (vi) Provide water-tightness by the use of "pressure equalization and rain screen" curtain wall design principles. This may be enhanced by the use of drained gutter systems and/or the provision of weep holes to enable water to be controlled and diverted to the exterior.

- (vii) Provide a complete external envelope which is accessible internally or externally for maintenance.

Tender submission

16.07

Not used.

Provision of drawings and calculations

16.09

Provide the following submittals for approval as specified. First submittals and resubmittals shall be complete and in the required form. Resubmittals shall include requested corrections and shall respond to previous comments.

Each sheet that is revised shall bear a revision date and number. Revisions shall be flagged with a conspicuous revision symbol and number. Failure of a submittal to be complete, in the proper form, responsive to comments, or identified with revisions shall, at the SO's discretion, be a cause for non-approval and return of documents without review.

Failure of reviewing comments to note a noncompliance with the Specification and Drawings shall not relieve the Contractor from his obligation to comply. The failure of the Contractor to note a noncompliance on a given submittal shall not preclude a directive by the SO for the Contractor to comply on future submittals. Allow sufficient time for preparation and processing of submittals and resubmittals.

- (i) Provide drawings certified by a qualified structural engineer, showing materials in place. Drawings shall be fully co-ordinated to allow identification from elevation to section and from section to elevation. Drawings must include elevations, floor plans, sections and full size details. Details shall be fully drawn (not outlined). Drawings shall include the following information:
 - (a) Assembly and water-tightness and/or pressure equalization and rain screen system of curtain wall.
 - (b) Glass and metal thicknesses.
 - (c) Metal alloy, temper and finish.
 - (d) Glass strength, tint, coating, opacifier, frit and safety backing.
 - (e) Fastener alloy, strength, plating, diameter, length and spacing.
 - (f) Glazing materials identification.
 - (g) Sealants identification by product name.
 - (h) Relative layout of walls, beams, columns and slabs with dimensions noted.
 - (i) Dimensioned position of glass edge relative to metal surface.
 - (j) Provisions for thermal movements and building movements.
 - (k) Locations of, and details for, any embedded anchors.
 - (l) Identification of, and details for, thermal insulation.
 - (m) Weld information and weld symbols conforming to **BS 499-2C**, **BS EN ISO 2553**.

- (n) Glazing details applicable to replacement glass, with outline of procedure for glass replacement.
 - (o) A drawing to show any changes to the typical anchorage system required to accommodate the maximum and minimum concrete condition is to be provided to confirm that provisions for adjustment of anchors, relative to tolerances of building structure, has been considered.
 - (p) Details of spandrels, copings, louvres and operable window.
 - (q) Details of ceiling and bottom/floor closure panels or strips if applicable.
 - (r) Details of fire barriers between perimeters of floors and curtain wall.
 - (s) Details of lightning protection.
 - (t) Location of equipotential bonding points.
- (ii) Provide shop drawings and fully coordinated structural calculations, certified by a qualified structural engineer, as specified. Calculations shall be legible and shall incorporate sufficient cross references to the shop drawings to make the calculations readily understandable and reviewable. Test reports shall not be an acceptable substitute for calculations. Calculations shall include the following information:
- (a) Analysis for all applicable loads on framing members.
 - (b) Analysis for all applicable loads on anchors, including anchors embedded in concrete.
 - (c) Section property computations for framing members.
 - (d) Analysis of stress in structural silicone applications at vision or spandrel glass lights, stiffeners to panels and all other areas where silicone is used to retain items subject to structural loading.
 - (e) Certification of a Registered Structural Engineer.
- (iii) Drawings and structural calculations shall be required for test mock-ups. The requirements for test mock ups shall generally be the same as for the actual Works, with particular reference to mock-up conditions.
- (iv) Additional submittal requirements:
- (a) Prior to, or at the same time as, the first submittal of structural calculations for approval, provide dimensioned die drawings for all aluminium extrusions.
 - (b) In the event that extrusion profiles are not finalized, provide die drawings for the profiles contemplated at that time. If profiles are revised, provide revised die drawings with the first calculation or shop drawing submittal which follows the revision.

- (c) Die drawings shall show all profile dimension, metal thickness, alloy and temper.
- (d) Prior to construction, provide die drawings of gaskets and weather-strips. Die drawings shall show all profile dimensions and shall identify materials.
- (e) Prior to construction, provide glass manufacturer's wind pressure analysis and thermal stress analysis, as well as glass manufacturer's review of shop drawings stating that details shall be suitable for the proposed glass products.
- (f) Prior to construction, provide sealant manufacturer's test reports confirming sealant adhesion, compatibility and absence of staining for all relevant substrates and sealant manufacturer's print review report stating that the sealant manufacturer has reviewed all the shop drawings and accepted the glazing details, conditions and glazing materials for the satisfactory performance of the sealant. This includes all materials that are designed to or may come into contact with sealants.
- (g) Prior to construction, provide certification that, as a minimum, insulating glass conforms to **BS EN 1279**.
- (h) Prior to submitting any documents for approval, submit laboratory test reports for structural silicone assembly, as required under TESTING.
- (v) Samples of materials:
 - (a) Submit together with Clause 16.09 (i) above, samples of all materials together with fully glazed samples of principal junctions and assemblies.
 - (b) Submission shall consist of three samples of each material and principal junction or assembly, two to be retained by the SO, and the other to be returned after approval. Approved samples shall be so marked by the SO. Samples of materials required shall be as follows:

Aluminium/Stainless steel sections	300 mm length of each.
Galvanized mild steel	300 mm length of each section.
Sheet, plate, mesh	500 x 1000 mm piece of each type.
Glass	600 x 600 mm piece per type and/or edge finish.
Fastening devices	Each type.
Sealants	150 mm cured sample each type.
Gaskets	300 mm length of each type.
Flashings	300 x 300 mm piece of each type.

Stone	300 x 300 mm piece of each type.
Access panel/sash window	500 x 500 mm part with all accessories.

Samples shall show the complete range of colour, texture and other characteristic changes through the manufacture, fabrication, assembly, installation and cleaning processes.

Submit finished samples of every extrusion or section to be used and of every other material of the thickness and weight as required by the SO. Aluminium samples shall include samples of high and low colour range of anodic and organic coating finish and shall be labeled accordingly. Stone samples should include the name of the quarry and country, and consist of full range of color, texture and the grading of the stone.

Where the sample size is not sufficient to show all differences in appearance, such as stone panels, the Contractor must specify any additional discontinuities, changes to colour texture or other changes that will affect the appearance and/or performance.

(vi) Erection and protection method statement

Submit together with Clause 16.09 (i) above, a detailed method statement for erection and protection of the Works. This should include details of storage and protection when materials are stored on site prior to installation.

(vii) Mock-up samples

Refer to in Clause 16.72.

(viii) Structural adequacy tests of anchorages

Refer to in Clause 16.74.

Steel	16.11	(i)	Stainless steel shall be to BS EN 10048:1997 , BS EN 10095:1999 , BS EN ISO 9445-1:2010 , BS EN ISO 9445-2:2010 grading not inferior to 304 S15 with minimum thickness of 1 mm 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 9445-1:2010 , BS EN ISO 9445-2:2010 . Alternatively, stainless steel shall be to BS EN 10088:2014 of corresponding grading with properties not inferior to Grade 1.4301(304 S15).
		(ii)	Structural steel shall be to Clause 15.02 and 15.03, galvanized in accordance with Clause 15.63 and tested in accordance with Clause 15.17.
Anchors in concrete and masonry	16.17	(iii)	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 1461:2009 . Galvanize steel parts of anchors. After field welding, remove weld slag and touch up affected area as specified in Clause 15.63.

- (iv) Strength of embedded anchors shall be developed by integral projections or by welded deformed bars or headed studs.
- (v) 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.
- (vi) 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.
- (vii) Self drilling, self threading screws shall not be acceptable.
- (viii) Screw-in plugs and powder actuated fasteners shall not be acceptable.
- (ix) Areas where curtain walls are installed in “wet area”/“area exposed to weather”, anchors are upgraded to Stainless Steel Anchors embedded in concrete.
- (x) 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

16.18

- (i) Fastener requirements listed below shall be applicable to screws, bolts, nuts, washers, rivets and pins.
- (ii) Stainless steel fasteners shall be to **BS EN ISO 3506-1** and **BS EN ISO 3506-2** on Specification 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.
- (iii) Stainless steel washers shall comply with **BS 4320:1968** and **BS 4464:1969** as far as sizes and tolerances are concerned.
- (iv) Bolts, screws, nuts and washers shall be to Clause 15.06, 15.07 and 15.39, as a minimum, galvanized to Clause 15.63 and tested to Clause 15.20.
- (v) Provide lock washer or other locking device at all bolted connections.
- (vi) Powder actuated fasteners shall not be acceptable.
- (vii) Aluminium fasteners shall be to **BS 1473:1972**.
- (viii) Actions subsequent to any failure of material or test specimens shall be in accordance with the requirements of Clause 15.21.
- (ix) The mechanical properties, dimensions, load capacities and specific proprietary model number/series of metal spider fixing and the fixing components shall be shown in relevant drawings and submitted for approval. The Contractor shall carry out proof load testing of spider fixing.

**Operable
windows**

16.23

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-116**, **BS 4873**, **BS 6375-1+A1**, **BS 6375-2** and **BS 6375-3+A1**:

- (i) 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.
- (ii) The required test specimen size is the maximum size operable window for this project.
- (iii) Locks and strikes shall be white bronze or type 302, 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.
- (iv) Fixed frames and vent frames shall be extruded aluminium with an acceptable factory applied finish. Vent frames shall consist of a tubular profile.
- (v) 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.
- (vi) If an integral pivot is not used, balance arms shall be provided and these shall be four-bar 300 series stainless steel type 302, 304 or 316 with adjustable friction shoe. Provide two balance arms per vent.
- (vii) Provide two limit stops per operable window. Material shall be 300 series stainless steel type 302, 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.
- (viii) Operable windows are to have removable handles or special keys to enable the windows to be opened.
- (ix) 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**

16.24

- (i) Honeycomb Panels
 - (a) 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
 - (b) 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.

- (c) 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.
- (d) Adhesive shall be a thermal setting modified epoxy with a minimum set temperature of 121°C. The adhesive shall form a fillet at the perimeter of each cell, and shall continuously bond each cell to the face and back sheets.
- (e) The face sheet, back sheet, and core of each panel shall be cut from single pieces of material. No joinery shall be permitted unless the size of the panel exceeds the sizes that are commercially available.
- (f) 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.
- (g) 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.

(ii) Composite Panels

- (a) 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.
- (b) 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
- (c) Core shall be entirely of non-combustible materials which meet the requirements of **BS 476-4** or **BS EN 13501-1** Class A1.
- (d) 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.
- (e) Provide formed edge returns with a residual core thickness of 0.2 to 0.4mm and seal edges with reinforcements and silicone sealant.
- (f) Structural support must be provided by means other than the return edge.
- (g) Bonding surfaces shall be chemically pretreated to assure effective and durable bond.
- (h) Other facing materials may also be suitable and will only be permitted if approved prior to use.

**Organic coating
finish to
aluminium** **16.32**

Organic coating finish shall comply with the following general requirements:

Also refer to Section 17 of this GS.

- (i) All coatings, when cured, shall be visibly free of flow lines, streaks, sags, blisters or other surface imperfections. Extrusions shall be free from visible die lines that will show through the organic paint system. In the event that die lines occur, the coating supplier shall specify an appropriate treatment that will fully comply with the specification and warranty requirements.
- (ii) All finishes shall match in gloss, and fall within the colour range of the approved samples. 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 gloss retention of the organic coating. These shall be submitted for approval prior to the commencement of production.
- (iii) 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 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.

Pretreat 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/m² of substrate removal. Interior coatings require etching to a depth of 1 g/m². Where possible "Chrome Free" chromate conversion should be carried out

in accordance with a procedure that is acceptable to the organic coating supplier.

Welding

16.39

Welding of steel shall be in accordance with **BS EN 1011-1**.

Welding of aluminium shall be to **BS EN 1011-4**.

Welding of Aluminium shall be tested to **BS EN ISO 4136** Destructive tests on welds in metallic materials - Transverse tensile test, **BS EN ISO 5173** Destructive tests on welds in metallic materials - Bend tests, **BS EN 1320** Destructive tests on welds in metallic materials - Fracture tests and **BS EN 1321** Destructive test on welds in metallic materials - Macroscopic and microscopic examination of welds.

The type, size and spacing of welds shall be as shown on the agreed shop drawings. Welding materials and methods shall be such as not to cause distortion, discolouration, or result in any other adverse effect on the required profiles and finishes of the exposed curtain wall.

Weld spatter and welding oxides on exposed surfaces shall be removed, and prime painted with zinc rich coating.

Unless otherwise shown or specified, weld beads on exposed surfaces shall be ground and finished to match and blend with finish on adjacent metal. Grinding and polishing of nonferrous metal shall be done only with clean wheels and compounds free from iron and iron compounds. No soldering and/or brazing shall be allowed.

Structural requirements

16.46

- (i) Pressures and loads used for design shall be as calculated in accordance with the requirements of Code of Practice on Wind Effects in Hong Kong and **APP-139** or as indicated by the results of a boundary layer wind tunnel test. A boundary layer wind tunnel test shall be carried out if it is specified.
- (ii) Wind pressures act perpendicular to flat surfaces, regardless of surface orientation. Wind pressures act perpendicular to tangents of curved surfaces. At corners and other changes in plane, both surfaces shall be assumed to experience their inward design pressures simultaneously, and their outward design pressures simultaneously. Design for simultaneous occurrence of inward design pressure on one surface, and outward design pressure on the adjoining surface, is not required.
- (iii) Unless agreed to the contrary, minimum design pressure loads shall be:
 - outward (negative) wind pressure 2.82 kPa.
 - inward (positive) wind pressure 2.01 kPa.
- (iv) When protective barrier is not provided separately, the use of curtain wall glazing as protective barrier shall comply with all the structural requirements as specified in **APP-110**. Horizontal imposed loads specified in Table 3 of Regulation 17(3) of the Building (Construction) Regulations shall also be catered for in the design.

Condensation gutters

16.58

Sloped and horizontal walls shall have continuous condensation gutters of the same material (Aluminium/Stainless steel) at all framing members. Condensation shall be wept to the exterior.

		The design and installation of the condensation gutters shall follow BS 5250+A1 on Code of Practice for Control of Condensation.
Criteria for painted finishes	16.63	<p>Performance requirements for painted finishes on aluminium shall be as follows:</p> <ul style="list-style-type: none"> (i) As a minimum, comply with the relevant parts of BS 4842, BS 12206-1 and the AAMA 2604 or AAMA 2605 standard. (ii) Paint film shall not crack or peel during the specified special warranty period.
Criteria for operable window	16.66	<p>Criteria for operable windows shall be as follows:</p> <ul style="list-style-type: none"> (i) Operable windows shall to the GS. In addition, and as a minimum, operable windows shall also conform to BS 4873, BS 6375-1+A1, BS 6375-2 and BS 6375-3+A1. (ii) Prior to any other mock-up tests, operable windows shall be unlocked, fully opened, closed and locked for a minimum of 50 cycles. If any repairs or adjustments are performed after cycling, the minimum 50 cycles shall be repeated. Mock-up specimens shall be tested for water leakage. (iii) As part of any mock-up tests, provide separate window vents in fixed frames to the laboratory for tests per BS 6375-2:2009. (iv) Operable windows shall be complete with ironmongery and accessories and only operable by special keys. (v) Hinges and fastening mechanisms shall withstand positive and negative pressures due to specified wind conditions when the windows are in both open and closed positions.
Fire resistance	16.70	<p>Curtain wall, which protects the building against the elements and which extends beyond one storey in height, should be constructed entirely of non-combustible materials (except for window sealants and gaskets) according to Code of Practice for Fire Safety in Buildings. The top and bottom gaps between the structural floor slabs and related beams and the panels of the curtain wall shall be completely sealed up with fire resistant material, having a Fire Resistance Rating (FRR) of not less than that of the floor slabs, against fire and smoke. Anchorages between the curtain wall and the structure shall be similarly protected with fire proof material to give a total resistant period of 2 hours. The fire resistant material in the gaps between the curtain wall and the structural floor and related beams shall be rigidly fixed to the structure continuously such that it shall remain in position when subjected to the prolonged action of heat and fire. Asbestos products shall not be used. Test, if specified, to the relevant clauses of BS 476: Part 4 for External Curtain Wall System to determine the resistant period for stability and integrity.</p>
Laboratory tests of stone	16.77	<ul style="list-style-type: none"> (i) Submit for record only reports by an independent testing laboratory for tests conducted within 30 days of submittal date. Submit written certifications that test specimens are representative of production material for this project. Provide a minimum 2 week advance notice to SO before conducting stone tests. Provide access to testing laboratory during tests.

Unless an alternative acceptable method of determining the allowable design strength of the stone is used, such as Method 1 for aged stone or Method 2 for non-aged stone, as stated by the CWCT, the following methodology must be applied.

It must also be noted that thermal and age testing of all stone other than granite must be carried out. Stone used for this purpose must be cut from the same block as the original tested stone. If the number of thermal cycles used are less than that stated by the CWCT, then the worst case durability and deviation factors given by CWCT must be used.

- (ii) As used in this Specification, the term "rift" means the plane of easiest splitting. In stratified stones, rift is assumed to coincide with the bedding or stratification. Rift shall be identified by the quarryman on all test samples, and the identification shall be marked on all test specimens by the party preparing the specimens. As used in this specification, the term "specimen" means a single piece of stone or an anchor-in-stone assembly having specific shape, size and surface finishes.
- (iii) Perform tests for the following properties:
 - (a) Flexural strength per **ASTM C880/C880M-09**.
 - (b) Stone strength at anchors as defined herein.
 - (c) Water porosity as defined herein.
 - (d) Density per **ASTM C97/C97M-09**.
- (iv) Specimens tested per **ASTM C880/C880M-09** shall have the following surface finishes:
 - (a) The outdoor surface shall have its production finish and shall be the tension side.
 - (b) The indoor surface shall have its production finish and shall be the compression side.
 - (c) Edges shall have a finely sawn finish.
 - (d) Separate groups of specimens shall be required for each outdoor finish to be provided.
- (v) Specimens tested per **ASTM C880/C880M-09** shall have the following nominal dimensions:
 - (a) Depth shall be equal to proposed thickness.
 - (b) Width equals 100 mm when thickness is less than 70mm, or shall be equal to 1.5 times the thickness when thickness is greater than 70 mm.
 - (c) The span as tested shall be equal to 10 times thickness.
 - (d) Overall length shall be not less than 50 mm and not more than 100 mm greater than the span as tested.

- (vi) Results shall be reported for all specimens tested. No result shall be disregarded in computing average values.
- (vii) At least 20 specimens each, representing at least 5 different quarry blocks shall be tested per **ASTM C880/C880M-09**. Separate sets of 20 or more specimens shall be required for each outdoor finish for **ASTM C880/C880M-09** tests. Each group of 20 or more specimens shall consist of 4 subgroups of 5 or more specimens, representing all possible combinations of quarry block, wet or dry conditioning, and loading parallel or perpendicular to rift. Each specimen shall be identified by quarry block, wet or dry conditioning and loading direction.
- (viii) Bending strength used to compute allowable stress shall be the smallest of the average values computed for each subgroup of 5 or more specimens tested per **ASTM C880/C880M-09**.
- (ix) For each type of proposed stone anchor, carry out tests in accordance with **ASTM C1354/C1354M-09**. Test at least ten specimens, two from each of five different quarry blocks. Test at least five specimens, each from a different block, with inward load, and at least five specimens with outward load. Crosshead movement shall not exceed 0.63 mm per minute. Wet or dry condition of stone shall correspond to the weaker condition as determined by flexural strength. Orientation of rift plane shall correspond to orientation on the building. Stone thicknesses shall be minimum (nominal thickness minus tolerance) for anchor test specimens. Continuous kerf type anchors which exceed 300 mm in length may be tested as 300 mm long specimens and the results interpreted as stress in the stone at the bottom of the kerf cut. Results shall be reported for all specimens tested. No result shall be disregarded. Strength of stone at an anchor used to compute allowable values shall be the average value for each group of 5 or more specimens.
- (x) For each proposed stone type and finish, perform a water porosity test. A minimum of three specimens shall be required, each having the correct outdoor finish, indoor finish and thickness. Each specimen shall be taken from a different quarry block. Minimum specimen size is 300 mm by 300mm. Place specimens in a horizontal position, outdoor surface facing upward, such that the indoor surface is clearly visible and is not in contact with any other surface, other than small supports. Air temperature shall be in the range 18 to 29°C. Seal to the outdoor stone surface a circular or square sleeve having an internal cross sectional area of at least 180 square cm. The sleeve shall be at least 50 mm from stone edges. Fill sleeve with cold tap water to a depth of 250 ± 6 mm. Maintain test conditions for 7 days. Record the times at which dampness (if any) is first visible on the indoor stone surface; water droplets (if any) are first visible on the indoor stone surface; dripping of water (if any) from the indoor stone surface begins. If dripping occurs, once during each 24 hour period collect the water for one hour and record the volume collected. The formation of water droplets on the indoor stone surface (with or without dripping) constitutes failure. All specimens tested shall pass.

- (xi) Based on the above test requirements, minimum quantities of test specimens shall be as follows. To assure adequate quantities for testing, at least twice the minimum number of specimens shall be prepared.
 - (a) **ASTM C880/C880M-09**; total of (20) specimens, (4) specimens taken from each of (5) quarry blocks.
 - (b) Separate sets of (20) or more specimens shall be required for each outdoor finish for **ASTM C880/C880M-09** tests.
 - (c) Each anchor type in stone; (10) specimens, (2) from each of (5) quarry blocks.
 - (d) Water porosity test; (3) specimens for each outdoor finish; each specimen from a different quarry block.
 - (e) **ASTM C97/C97M-09** (density); total of (6) specimens, (3) specimens taken from each of (2) quarry blocks.
- (xii) In addition to the testing programme described above, quality control testing shall be required. For each type of stone, flexural specimens shall be wire sawn from a minimum of five percent of the total number of quarry blocks. Size of specimens shall be as specified herein. For each of the sampled blocks, flexural strength shall be determined per **ASTM C880/C880M-09** for two specimens. If at least one of the two specimens for each sampled block has flexural strength equal to or greater than 80 percent of the design bending strength as specified herein, no further testing or reduction in working stress is required. If for one or more sampled blocks, both specimens have flexural strength less than 80 percent of the design bending strength, additional testing or a reduction in working stress shall be required. The additional testing option consists of applying the two-specimen test and 80 percent rule to each quarry block. For any block which fails, the two-specimen test and 80 percent rule may be used for each slab cut from the block. Any slab which fails shall be rejected; any block which fails shall be rejected unless its slabs are checked individually. The reduction in working stress option consists of reducing the allowable bending stress in stone, and the allowable load exerted on stone by an anchor, both of which are derived from the results of other tests specified herein. The reduction factor shall be the average of specimens from blocks which failed the 80 percent rule (both specimens included in average) divided by the original bending strength. Quality control test results shall not be used to increase allowable bending stress or allowable load exerted on stone by an anchor.

Test reports

16.78

Submit a certified laboratory test report in accordance with **BS 5368-4**. Include the following for the tests carried out under Clause 16.73:

- (i) Test results together with comparison with permitted parameters.
- (ii) Remarks and conclusions by the testing professionals.

Submit photographic records of the test arrangement, set-up and of the performance of the mock-ups, and constituent components of the same, during fabrication, assembly and under test.

Provide two copies of the agreed shop drawings for recording any modifications found necessary during and after the laboratory tests. The testing laboratory shall accurately and neatly record all changes, revisions, and modifications etc., made to the shop drawings. At completion of the testing, the marked-up drawings shall be passed to the SO.

Subsequently and before any installation work commences on the site provide the SO with six copies of the shop drawings incorporating the modifications made.

Amendments to Section 17

Slotted steel angle	17.05	Slotted steel angle shall be self-finished angle. Fittings to be stainless steel.
Adhesive for metal	17.12	<p>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 – 08. Peel strength to ASTM D903-98. Impact strength of adhesive bonds to ASTM D950-03.</p> <p>The VOC content of adhesive shall not exceed the maximum VOC content limits as stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation (Cap.311W).</p>
Finishing to steel	17.21	<p>Finishes to steel shall be as follows:</p> <ul style="list-style-type: none"> (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. <p>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.</p> <p>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.</p>
Chromium plating	17.23	<p>Chromium plating shall be to BS EN ISO 1456, for "service condition No. 3", with "bright", "dull" or "satin" finish.</p> <p>Hexavalent chromium plating shall not be applied to window components.</p>
Aluminium windows and doors	17.33	<p>Aluminium windows and doors shall be obtained from an approved manufacturer and constructed in accordance with the following: -</p> <ul style="list-style-type: none"> (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 1/180th 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 16.31 for anodic coating.
 - (ii) Refer to Clause 16.32 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 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 degree 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:
 - (a) Diecast zinc alloy to **BS EN 1774** suitably coloured to match the anodised window or door metal.
 - (b) 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. N.B. 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 square. 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 Site.
- (r) Return to site on completion of building work, carefully remove protective coating and leave clean.

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, Fire Services Department and the Building Services Branch Testing and Commissioning Procedure No. 3 for Fire Service Installation in Government Buildings, 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**.

A test report prepared by an Accredited Laboratory or Building Authority shall be provided to certify that the fire resisting shutter is capable of resisting the action of fire for the specified 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 Fire Service Installation in Government Buildings of the Hong Kong Special Administrative Region, Architectural Services Department.

Sealant for metal 17.45

The VOC content of sealant shall not exceed the maximum VOC content limits as stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation (Cap.311W).

Amendments to Section 18

Sand 18.03

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

**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			Blb	Blb	Blb
1. *Water absorption (%)	Average	BS EN ISO 10545-3	<= 3	<= 3	<= 3
	Individual		<= 3.3	<= 3.3	<= 3.3
2. *Modulus of rupture (N/mm ²)	Average	BS EN ISO 10545-4	>= 30	>= 30	>= 30
	Individual		>=27	>=27	>=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 ‘*’, valid test certificates (original or certified true copies issued by the testing laboratories) for tests carried out within the past 12 months are acceptable as evidence of compliance to SO’s satisfaction.

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 ‘*’, valid test certificates (original or certified true copies issued by the testing laboratories) for tests carried out within the past 12 months are acceptable as evidence of compliance to SO’s satisfaction;

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	DIN 51130	R11 (or R10 V4) or above		

Amendments to Section 19

Generally	19.01	<p>All plumbing work shall be in compliance with the Water Authority's requirements and Waterworks Regulations.</p> <p>The water usage for all products shall meet the Grade 1 water efficiency rating (i.e. nominal flow rate of less than or equal to 9 litres per minute) for Showers for Bathing of the Voluntary Water Efficiency Labelling Scheme (WELS) of Water Supplies Department unless product with other water efficiency ratings is required to meet particular functional purpose as specified in the Particular Specification.</p> <p>All products shall not contain heavy metals like lead, cadmium, mercury or hexavalent chromium and organically bound halogens.</p>
Scope of Work	19.02	<p>This Section covers all sanitary appliances supplied by the Contractor and the installation of all sanitary appliances, including those supplied by the Employer.</p> <p>This part of the GS shall be read in conjunction with the General Specification for Plumbing and General Specification for Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region published by the ArchSD, HKSAR. The General Requirements as stated in Section A2 and A3 in the General Specification for Plumbing and Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region shall be complied with.</p>
Stainless steel sinks	19.09.02	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.
Squat type W.C	19.11.02	Vitreous china Squat type W.C. pans to Singapore Standard SS 379 .
Flushing cistern	19.11.03	<p>The toilet should be dual-flush type, and the maximum flushing-water volume should be less than 3 liters and 6 liters per reduce flush and per full flush respectively, complete with flushing apparatus, discharge pipe, ball valve and overflow, of one of the following types as specified:</p> <ul style="list-style-type: none"> (a) Low level plastic. (b) High level plastic. (c) Low level vitreous china. (d) Close coupled vitreous china. <p>Sensor valve where specified for automatic flushing shall conform to Dezinification resistant brass (DZR brass) to BS EN 12164's CW602N. Operating pressure shall be 0.5 – 10 bar rinse. Time-off control approx. 10 sec. and remote adjust from 1.5 – 30 sec. The sensor shall either be operated by 6V Lithium battery or 220V AC power step down to 6V.</p>

Sensor fittings shall be suitable for use in salt water application.

Urinals	19.12	Wall hung urinals to BS EN 13407 . Vitreous china bowl type to BS 5520 with 50 mm diameter of waste outlet, complete with vitreous china automatic flushing cistern to BS 1876 , chromium plated flush pipes and spreaders to suit the number of appliances. The discharge volume shall be not more than 4.5 litres for every basin or stall, or for every metre of a trough urinal.
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Sensor valve shall conform to Dezinification resistant brass (DZR brass) to **BS EN 12164**'s CW602N. Operating pressure shall be 0.3 – 10 bar rinse. Time-off control approx. 9 sec. and remote adjust from 7 -22 sec. The sensor shall either be operated by 6V Lithium battery or 220V AC power step down to 6V.

Sensor fittings shall be suitable for use in salt water application.

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 Supervising Officer.
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Fireclay and vitreous china are defined in Clauses A2.2 and A2.1 of Annex A, **BS EN 14516:2006+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 17.09 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. Custom made size slab urinal may be straight, L-shaped or U-shaped as shown on the drawings with join and the length of slab as approved by Supervising Officer.
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Silicone Sealant	19.17	Silicone sealants shall be to BS EN ISO 11600+A1 .
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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 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.

Fixing wash basins	19.22	Wash basins shall be supported on approved proprietary brackets to suit the basins or counter top as shown on drawings or manufacturer's details.
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Water tight seal between the walls and the basins shall be made by using silicone sealant.

Fixing W.C. pans	19.23	Fix W.C. pans as follows:
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(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.

Amendments to Section 20

Generally	20.00	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	20.00.01	Comply with the documents contained in this Specification as defined in Index 3, regarding Ordinances, Regulations, Code of Practices, Standards and PNAP 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	20.01	Glass generally shall be in accordance to BS EN 952:1999 or ASTM C1036 - 16 .
Flatness	20.01.04	<p>In addition to conforming to BS EN 952:1999 and ASTM C1048 - 12e1, monolithic heat strengthened and tempered glass shall conform to the following flatness tolerances:</p> <ul style="list-style-type: none"> (i) 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. (ii) Localized bow refers to any straight line segment with a length of 300 mm on a glass surface. (iii) 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. (iv) Localized bow shall not exceed 1.6 mm. (v) 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 – 12e1, Table 2 for gauge lengths exceeding 2.40 m. (vi) 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.

- (vii) The specified bow and ripple tolerances are intended as manufacturing quality control limits.

Criteria for glass 20.01.09

Performance requirements for glass shall be as follows:

- (i) For the purpose of glass selection, design wind pressure shall be assumed to have three second duration. Minimum roof imposed load shall be assumed to have one week duration.
- (ii) Upon first application of design wind and imposed load pressures, probability of breakage shall not exceed 8/1000 for vertical glass, and 1/1000 for sloped and horizontal glass.
- (iii) Provide heat strengthened glass where annealed glass would be vulnerable to thermal breakage.
- (iv) In addition, the allowable tensile stress of fully toughened glass (tempered glass) for use with unfactored loads shall not exceed the following:
 - (a) 50 N/mm² for unfactored wind loads.
 - (b) 35 N/mm² for medium and long-term unfactored loads.

Glazing materials 20.01.11

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:

- (i) Sponge gaskets shall be extruded black neoprene with a hardness of 40 +5/-4 durometer Shore A and conforming to **ASTM C509 - 15**. 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.
- (ii) 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 - 15** or **BS 4255-1**. Outdoor and indoor gaskets shall be silicone, EPDM, neoprene or a Thermal Plastic 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.
- (iii) Where compatible with the installation procedures, all corners are to be vulcanized by transfer/injection moulding.
- (iv) 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.

Float glass 20.02

Unless otherwise specified glass shall be considered as clear float annealed glass of a minimum Q3 quality in accordance with **ASTM C1036 – 16** or **BS EN 572-2**.

Mirror glass 20.06

Mirror glass shall be selected float suitable for silvering and a minimum Q2 quality in accordance with **ASTM C1036 - 16**.

Mirrors shall have square or bevelled edges. Exposed edges are to be ground or polished smooth with an arissed edge.

Heat strengthened glass

20.07

- (i) Heat strengthened glass shall be glass that has been heat treated to give increased strength, in accordance with the requirements of **ASTM C1048 – 12e1**, to approximately twice the strength and impact resistance of untreated float glass.
- (ii) To be defined as Heat Strengthened glass, the residual surface compression must be between 24 and 52 MPa.
- (iii) 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 14179-1:2016**. Submit the compliance certificate for the glass delivered to site. The compliance certificate should include the following information:
 - (a) Identification of the batch;
 - (b) Quantity and configuration of thermocouples used to measure the glass surface temperatures in the oven;
 - (c) 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;
 - (d) Name of the glass manufacturer;
 - (e) Location of the oven;
 - (f) Calibration report of the oven;
 - (g) Date of carrying out the heat soaking process;
 - (h) Quantity and size of glass subject to the heat soaking process and records of breakages of panels in the tests; and
 - (i) Minimum dimension of glass separation in the oven.
- (iv) Heat strengthened glass is not to be considered a safety glass.

Fully tempered glass

20.08

- (i) Fully tempered glass shall be glass that has been heat treated to give increased strength, in accordance with the requirements of **ASTM C1048 – 12e1**, to approximately four times the strength and impact resistance of untreated float glass.
- (ii) 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.
- (iii) 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**, 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**. The Contractor shall submit for approval the following items:

- (a) A quality supervision plan for the quality supervision of manufacturer's heat soak process of the tempered glass to be used.
- (b) 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.
- (c) The compliance certificate for the glass delivered to site. The compliance certificate should include the information as mentioned in Clause 20.07(iii).
- (iv) Fully tempered glass is considered a safety glass as upon fracture it would break into small fragments.

Tinted glass **20.09** 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 – 12e1** as a minimum.

Coated glass **20.10** Coated Glass

- (i) Coated glass shall be an approved proprietary product with either
 - (a) A metallic mirror-like reflective coating on the designated surface to the colour and of the type and performance specified or
 - (b) A pyrolitic or vacuum deposition low emissivity (Low-E) coating of the colour and of the type and performance specified in the Particular Specification.
- (ii) All coated glass must conform to the requirements of **ASTM C1376-10** or **BS EN 1096-1 to BS EN 1096-4** as a minimum but shall also conform to the requirements of the Particular Specification.
- (v) The thermal performance and other properties of the glass shall conform to the criteria in the Particular Specification.

Laminated safety and security glass **20.11** Laminated Glass, dependant upon its composition can be regarded as a safety glass or a security glass.

- (i) 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.
- (ii) Glass must conform to **ASTM C1172-14** or **BS 6262** 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.
- (iii) 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.
- (iv) Where non-pyrolitic 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 – 14** or other equivalent international standards for non-pyrolitic Low-E coatings.

- (v) When laminated glass is used in a sloped condition, that is at angle from the vertical in excess of 10 degrees, and heat treated glass is required for thermal or strength reasons, the inner lite is to heat strengthened and not fully tempered.
- (vi) 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.
- (vii) Certification is required for glass used in bullet resistance or blast resistant installations.
- (viii) 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.

Glazing compounds

20.16

Glazing compounds are to be selected to suit the frame and glazing substrates.

- (i) The following compounds are permitted to be used:
 - (a) 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.
 - (b) Polysulphide – is permitted only if the glass is positively retained on all edges.
 - (c) Putty – is permitted for glazing into wooden frames only. Putty for glazing to softwood and absorbent hardwoods shall be linseed oil putty to **BS EN 544:2011**. 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.
- (ii) Compounds for glazing plastic sheets shall be compatible with the proprietary sheets and are to be either silicone or polysulphide.
- (iii) All sealing compounds are to be tested for adhesion and the test reports submitted prior to the commencement of glazing.

WORKMANSHIP

Generally

20.17

The workmanship on glazing shall be generally in accordance with **BS 8000-7** and **BS 8000-0** and also conform to the glazing manual published by the Glass Association of North America (**GANA** – formerly **FGMA**).

Glazing shall be carried out from inside the building whenever possible. Glass and glazing materials shall be compatible with each other and the glass shall be protected from damage and staining of any kind.

Glass shall be new. Glass shall be of the specified type and quality with cleanly cut edges and sharp corners. Inspect glass before installation. Do not install defective glass.

Structural sealant glazing	20.26	Structural sealant glazing shall comply with APP-37 and APP-53 . It shall be applied according to BS 6262-6 , BS EN 13022-1 and BS EN 13022-2 . Only structural sealant recommended by manufacturer shall be used.
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Amendments to Section 21

Environmental Green Requirements	21.90	<p>(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.</p> <p>(b) Green requirements of Varnish and Wax Polish:</p> <p style="margin-left: 40px;">(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).</p> <p style="margin-left: 40px;">(ii) The product shall contain no more than 0.01% by wet weight of formaldehyde.</p> <p style="margin-left: 40px;">(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.</p>
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Amendments to Section 22

Construction of the system	22.01	<p>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).</p>
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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.

Screen fabric	22.29	<p>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 2007+A1 Specification for resistance to ignition or its international equivalent if polyurethane foam material is adopted. For other materials, fabric and form shall have the surface spread of flame of Class 1. The fabric shall be available with a reasonable choice of colours, and shall be specially designed for covering office screens</p>
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Compartments	22.71	<p>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.</p>
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Stacks of lockers may be connected together to form a block.

Amendments to Section 23

GS and T&C Procedure for plumbing & drainage	23.01	Comply with all the requirements for plumbing and drainage works, including General Requirements, Installation Methodology, Material and Equipment Specification, Inspection, Testing and Commissioning, and Operation and Maintenance as stipulated in the General Specification for Plumbing Installation in Government Buildings of the HKSAR 2017 Edition; General Specification for Drainage Installation in Government Buildings of the HKSAR 2017 Edition; Testing and Commissioning Procedures for Plumbing Installation in Government Buildings of the HKSAR 2017 Edition; and Testing and Commissioning Procedures for Drainage Installation in Government Buildings of the HKSAR 2017 Edition.
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Amendments to Section 24

Roads, car-parks and paved areas generally	24.01	<p>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 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 (2006 Edition), issued by 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.</p>
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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 the 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 (2012 Edition), the General Specification for Civil Engineering Works (2006 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 Highways Department for maintenance, such works shall be constructed in compliance with Highways standards as promulgated by Highways Department.

Insitu concrete paving	24.02	Insitu concrete paving, channels and kerbs shall be constructed in accordance with Structural Concrete Work - Section 6 or if so specified in accordance with Concrete for Minor and Non-structural Works - Section 8. Where the works involved are of a major nature or involves the construction of footways, cycle tracks and paved areas, such works need to comply with Section 10 on Concrete Carriageways or Part 6 of Section 11 on Miscellaneous Roadworks in the General Specification for Civil Engineering Works (2006 Edition), issued by Civil Engineering and Development Department.
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Construction of typical concrete pavement construction shall be in accordance with Highways Department Standard Drawing No. 1102A, unless otherwise specified in Drawings or approved by the SO.

Amendments to Section 25

Stockpile areas	25.09	(a)	Obtain approval of stockpile areas prior to the commencement of any stockpiling of materials.
Stockpile stability		(b)	Stabilize firmly all soiling materials stockpiled against wind blow and erosion by water, at all times.
Stockpile reclamation		(c)	Clean and make good the surface of any stockpile to its original condition at the completion of soil preparation work.
Stockpile maintenance		(d)	Maintain the stockpile free from over-compaction and any source of contamination.
Forming and handling soil heaps		(e)	For stripping and storage of Topsoil and all other soiling materials, soil heaps shall be formed and handled in workmanship in accordance with BS 4428 with reference to BS 3882 .
Definitions on trees	25.69	(a)	“tree” means a plant with diameter at breast height measuring 95 mm or more. Plants growing on retaining structures shall also be measured and considered.
Old and Valuable Tree		(b)	“Old and Valuable Tree” (hereinafter referred to as OVT) means any tree included in the Register of Old and Valuable Trees posted at the website maintained by Leisure and Cultural Services Department and any other OVT designated by the Government (Agriculture, Fisheries and Conservation Department (AFCD) and Leisure and Cultural Services Department (LCSD)).
Diameter at Breast Height		(c)	“diameter at breast height” (DBH) means the diameter of the trunk of the plant measured at a height of 1300 mm above ground level. For trunk with an obviously elliptical cross-section, the diameter at breast height shall be the average of any two diameter measurements taken at right-angle.
Tree crown spread		(d)	“Tree crown spread” means the diameter of the tree crown defined by the outermost branches of the tree.
Tree height		(e)	“Tree height” means the height from ground level to the top of the tree.
Dripline		(f)	“Dripline” of a tree means the imaginary vertical plumb line that extends downward from the tips of the outermost tree branches and intersects the ground.
Tree Protection Zone		(g)	<p>(i) “Tree Protection Zone” (hereinafter referred to as TPZ) means an area the perimeter of which is defined by the dripline of the tree. For a non-OVT growing on a retaining structure/wall/rock surface, the tree protection zone should encompass the body of the tree itself, and the vertical and horizontal surfaces of the retaining structure/wall covered by the tree roots.</p> <p>(ii) For an OVT, the TPZ refers to the zone encompassing the concerned tree along its dripline and extending vertically to 2000 mm upward beyond the top of the tree and 2000 mm downward beyond the ground level at the trunk base of the tree. For an OVT growing on a retaining structure/wall/rock surface, the TPZ should encompass the body of the concerned tree itself and 2000 mm above the tree crown, as well as the</p>

vertical and horizontal surfaces of the retaining structure/wall/rock surface covered by the tree roots together with the space up to 2000 mm behind those surfaces.

Preserved tree		(h) “Preserved tree” means an existing tree, including OVT, not earmarked to be felled, which may be a tree to be retained at its existing location, a tree at its existing location prior to transplanting, or a tree transplanted within the Site.
Arboricultural work		(i) “Arboricultural work” means any work related to the cultivation and care of trees for any purpose other than timber production, including but not limiting to planting, replanting, transplanting, pruning, tree surgery work and control of pest and disease.
Site supervisory staff and preservation and protection of existing trees	25.69.2	<p>(a) The Contractor shall assign a person to oversee the implementation of preservation and protection to existing trees. The person assigned shall be working full-time on the Site but not necessarily working solely for matters related to preservation and protection to existing trees.</p> <p>(b) The Contractor shall assign a competent member of the site supervisory staff to oversee and supervise tree works related to arboricultural operations and preservation of trees within the Site, including, but without limitation to, planting, transplanting, tree surgery work and control of pest and disease affecting trees on the Site. The person assigned shall be working full-time on the Site but not necessarily working solely on trees. The assigned person shall have attended relevant training on arboriculture organized by local / overseas training institutes (e.g. Construction Industry Council Training Academy, Vocational Training Council) with cumulative training of at least 30 hours in the past 3 years, and have at least two years practical experience in arboriculture. The Contractor shall submit to the SO for approval within 30 days of the date of the Employer’s letter of acceptance of the Tender particulars of the assigned person (including his name, experience and position) together with a copy of the certificate issued by the training institute confirming his / her satisfactory completion of the relevant course and supporting documents on the required experience.</p> <p>(c) The Contractor shall also comply with the requirements as stipulated in the following sub-clauses 25.69.2.1 to 25.69.2.5 (all inclusive), unless otherwise directed or agreed by the SO.</p>
Other references on arboricultural / tree work	25.69.14	<p>The Contractor’s attention is also drawn to the latest editions of the following British Standards and British Standard Code of Practice for general reference:</p> <p>BS 3998 Tree work – Recommendations</p> <p>BS 4428 Code of Practice for General Landscape Operations (Excluding Hard Surfaces)</p> <p>BS 5837 Trees in relation to Construction – Recommendations</p>
Preparation of planting pit at receptor site	25.74	(a) During planting pit preparation, the existing topsoil ploughed from digging shall be stripped and put aside for reuse as much as possible and to avoid a distinct interface between the pit and the surrounding soil.

		<ul style="list-style-type: none"> (b) The planting pit shall be: <ul style="list-style-type: none"> (i) with drainage to allow effective percolation of water; (ii) prepared to prevent settling; (iii) dug to the depth not exceeding the depth of the root ball and the sides of the pit shall be scarified; (iv) in terms of the width, at a minimum of 1.5 times the diameter of the root ball or as approved by the SO
Direct planting in receptor site	25.74.1	<ul style="list-style-type: none"> (a) Tree transplanted directly to the final receptor site is to be planted and secured, if required, in accordance with the Clauses 25.29 and 25.30, unless otherwise proposed by the Contractor and approved by the SO. (b) Synthetic or treated hessian around the root ball must be removed upon planting in the receptor site. Natural hessian should also be removed, if practicable, or to fold back, to ensure roots can grow out of the root ball. All pins and twines shall also be removed to avoid girdling the tree.
Replanting from holding nursery to receptor site	25.74.2	<ul style="list-style-type: none"> (a) Trees with root ball containerized shall be transported from holding nursery to the permanent receptor site with container intact. (b) The sides and bottom of the container shall be removed carefully by hand held tools without damage to the root ball. (c) Planting procedure shall be in accordance with Clauses 25.29 and 25.30, unless otherwise proposed by the Contractor and approved by the SO.
Immediate maintenance	25.74.3	<ul style="list-style-type: none"> (a) Plant materials shall be maintained immediately after transplanting works, from existing location for period as specified under Contract. (b) Such maintenance shall include all measures necessary to establish and maintain all plants in an acceptable vigorous and healthy growing condition. The establishment works shall be carried out in accordance with requirements under Clauses 25.93 to 25.105 and 25.109, unless otherwise proposed by the Contractor and approved by the SO.
Watering upon transplanting	25.74.4	<ul style="list-style-type: none"> (a) Immediately after transplanting, the base of all plants shall be well watered to thoroughly soak the root ball. Trees shall be well watered in evenings and early morning only.
Dry season watering		<ul style="list-style-type: none"> (b) Watering shall be carried out daily during the dry season, generally September to April, and as required during the wet season.
Mulch	25.74.5	A consolidated layer of 50 mm thick of mulch shall be placed around the tree, extending 150 mm beyond the perimeter of the tree pit and covering at least the entire root ball zone. Mulch shall not be placed immediately around the tree trunk or root collar.
Weeding to rootball	25.74.6	Rootball shall be kept free of weeds at all times and in accordance with Clauses 25.99 (a) to (e).

Crown cleaning	25.74.7	At the instruction of the SO, trees shall be pruned selectively to remove dead, damaged or dangerous branches. The pruning method of crown cleaning shall follow the requirements in Clauses 25.82 to 25.88.
Planting and maintenance of transplanted semi-mature trees	25.79	Clauses 25.74 to 25.74.7 shall apply.

Amendments to Section 26

Records of sprayed concrete	26.23	Keep records of sprayed concrete operations on the Site, and submit them daily to the SO. The records shall contain details of the quantities of all materials used at each location. The records could be either a hard copy or soft copy as agreed by the SO. The hard copy report shall use recycled papers. The soft copy shall be in read-only format and the hard copy shall be double side printed as agreed by the SO.
Material	26.34	<p>(a) Soil nail bars shall be of Grade 500B ribbed steel reinforcing bars to CS2. All steel components for soil nails shall be galvanized to BS EN ISO 1461.</p> <p>(b) Steel reinforcement for soil nail heads shall be Grade 500B ribbed steel reinforcing bars to CS2.</p> <p>(c) Nuts shall be of Grade 4 steel and comply with BS 4190.</p> <p>(d) Reinforcement connectors shall comply with Clause 6.24.</p> <p>(e) Bearing plates shall be of Grade S275 steel plate and comply with BS EN 10025. Steel plates for pull-out and performance tests shall be square with length not less than 300mm 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 2mm from the centroid of the plate. The clearance between the steel bar and the hole of the steel plate shall not be more than 2mm.</p> <p>(f) Concrete for soil nail heads shall be grade 30/20 or 30 MPa sprayed concrete and shall comply with Clauses 26.47-57 and Clauses 26.12-28 respectively.</p> <p>(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.</p> <p>(h) For soil nails using threaded type reinforcement connectors but without galvanized coating on either the threads inside the</p>

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.

Crushing strength of grout	26.55	<p>(i) A typical layout and design of soil nails is as shown in Appendix 4.</p> <p>(a) Provide one sample of grout from each batch of grout to determine the crushing strength of the grout. Provide samples not more than one hour after the grout has been mixed, and protect them from moisture content changes before test cubes are made.</p> <p>(b) Make nine 100 mm test cubes from each sample of grout taken as stated in Clause 26.55(a). Three test cubes shall be tested to determine the crushing strength at 3 days, three test cubes shall be tested to determine the crushing strength at 7 days, and three test cubes shall be tested to determine the crushing strength at 28 days.</p> <p>(c) The method of making, curing and testing the test cubes shall be as stated in CS 1.</p>
Relief drains	26.59	<p>(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.</p> <p>(b) Submit the following particulars of the proposed materials and methods of construction for relief drains to the SO :-</p> <p>(i) Details of relief drains and outlets, and</p> <p>(ii) Method of fixing relief drains to the slope face.</p> <p>(c) Submit the particulars to the SO for approval at least 14 days before fixing of relief drains starts.</p> <p>(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.</p> <p>(e) Construct a trial length of relief drains of at least 2 m.</p> <p>(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.</p>
Erosion control mats	26.63	<p>(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.</p> <p>(ii) Biodegradable mats for erosion control shall be woven coir mesh mats or woven jute mats.</p> <p>(iii) The mats shall have the material properties as stated in the Contract.</p>

- (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 the proposed materials and methods of construction for relief drains to the SO :-
 - (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 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) 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.
- (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 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 150mm and shall be formed with the upslope mat over the downslope mat. Do not form lapping within 1m of any intersection of two slope surfaces which have a sharp difference in slope gradient or strike direction.
 - (ii) 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.
 - (iii) 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.

**Painting to
sprayed concrete** **26.65**

- (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 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 12m²/litre 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 hours after application.

GENERAL SPECIFICATION FOR BUILDING 2012 EDITION

Major Changes from GS 2012 Corrigendum No. GS 2012-02 (August, 2016) to GS 2017 (October, 2017)

Clause No.	Sub-heading of Clause	Major Changes
Section 1 - Preliminaries		
1.02	Abbreviations	Replace the meaning of DEVB List from “Development Bureau current enforced List of Approved Suppliers of Materials or Specialist Contractors for Public Works” to “Development Bureau current enforced List of Approved Suppliers of Materials and Specialist Contractors for Public Works”.
1.09	Proprietary brand name materials or products	<p>Replace the sub-heading of Clause “Proprietary brand name materials or products” to “Proprietary brand name products or materials”.</p> <p>Replace “alternative materials” with “alternative products or materials” and “materials or products” with “products or materials”.</p>
1.12	Equivalent standards and imperial sizes	In the 1st paragraph, replace “materials or products” with “products or materials”.
1.20	Trees and shrubs	At the end of 4th paragraph, replace “G.S.” with “GS”.
1.39.3	Submissions	In sub-clause (i)(a), replace “Metal Scaffold System” with “metal Scaffold System”.
1.39.5	Construction	<p>In sub-clause (i)(e), replace “high-rise building” with “structure or building”.</p> <p>In sub-clause (i)(f), add “Where scaffolding is provided for structure or building which is under 30 m in height or is set back from the site boundary such that an inclined projection plane from the top outer edge of the structure or building at 10 degree from the vertical does not go beyond the site boundary at ground level,” before “Provide safety nets” and replace “Provide” with “provide”, “ the entire face of the building” with “ the entire face of the structure or building” and “The safety nets shall be tautly fixed with minimum lap of 450 mm in any direction” with “The safety nets shall be tautly fixed with minimum lap of 450 mm in any direction to the outer face of the scaffold”.</p> <p>Replace sub-clause no. “(i)(g)” with “(i)(i)”, “(i)(h)” with “(i)(j)”, “(i)(i)” with “(i)(k)”, “(i)(j)” with “(i)(l)” and “(i)(k)” with “(i)(m)”.</p> <p>Add sub-clause (i)(g) “Where scaffolding is provided for structure or building except those specified in sub-clause (f) of this Clause, provide safety nets consisting of two layers in accordance with Buildings Department Practice Note APP-102,” and add sub-clause (i)(h) “Use fire retardant material for safety nets,” after sub-clause (i)(g).</p>
1.39.7	Technical requirements for safety in bamboo scaffolding	<p>In sub-clause (ii)(a), replace “Drawing No. 3” with “Drawing No. SCAFFOLD/3”.</p> <p>In sub-clause (ii)(b), replace “Drawing No. 1 and 2” with “Drawing No. SCAFFOLD/1 and SCAFFOLD/2”.</p>
1.50	Specialist materials	Add “.” at the end of the paragraph.

Clause No.	Sub-heading of Clause	Major Changes
ANNEX A	Double Layer Scaffold System	<p>In drawing no. SCAFFOLD/1 and SCAFFOLD/2, replace “high-rise building” with “structure or building”.</p> <p>In drawing no. SCAFFOLD/3, replace “low-rise building” with “structure or building”.</p> <p>In title blocks of drawing no. SCAFFOLD/1, SCAFFOLD/2 and SCAFFOLD/3, replace “FEB 2012” with “FEB 2017”.</p>
Section 2 - Demolition, Site Clearance & Alterations		
2.01	Regulations, Ordinances, Codes of Practice & Practice Notes	In sub-clause (ii), replace “Supervision Plan” with “Supervision Plans”.
2.03	Registered Structural Engineer	<p>In the 1st paragraph, replace “Site Safety Supervision Plan (SSSP)” with “Supervision Plan”.</p> <p>In sub-clause (ii), replace “Contractor’s” with “Authorized Signatory’s” and “Site Safety Supervision Plan (SSSP)” with “Supervision Plan”.</p> <p>In sub-clause (v), replace “regular site visits” with “such periodical supervision and make such inspections as may be necessary”.</p> <p>In sub-clause (vii), replace “slopes and/or retaining walls” with “slopes, retaining walls and other geotechnical features” and “Professional Engineer (Geotechnical) (RPE(G))” with “Registered Geotechnical Engineer (RGE)”.</p> <p>Add sub-clause (viii) “Change of the RSE shall not be permitted without prior written consent of the SO. In case of change of RSE, the new RSE shall review and resubmit the method statements prepared by the former RSE and assume the role of Authorized Signatory’s Representative in the Contractor’s Stream under Supervision Plan.”</p>
2.04	Submission of Documents	<p>In sub-clause (i), add “and Stability Report including calculation”.</p> <p>In sub-clause (iii), replace “Site Safety Supervision Plan” with “Supervision Plan”.</p> <p>In the 3rd paragraph, add “and critical areas that may impact on the general safety of the public and on site personnel,” before “including but not limited to”.</p>
2.05	Demolition Plan and Method Statement	<p>Add “and Stability Report including calculation” after “Prepare a Demolition Plan”.</p> <p>In sub-clause (i), replace “item 2.20” with “item 2.11”.</p> <p>Add a new sub-clause (xii), “Stability checking calculations for the building to be demolished, its supports, if any, the adjoining properties and the loading due to powered mechanical plants, or equipment.”</p> <p>Replace sub-clause no. “(xii)” with “(xiii)”, “(xiii)” with “(xiv)” and “(xiv)” with “(xv)”.</p>

Clause No.	Sub-heading of Clause	Major Changes
2.06	Technically Competent Persons	In the 1st paragraph, delete “comprising not less than one person of each grade of TCP from T1 to T5 inclusive whereas the T1 and T3 grade TCP must be in full time, to carry out full time site supervision” and replace “Site Safety Supervision” with “Site Supervision”. In the 2nd paragraph, replace “Contractor’s Site Agent” with “RSE”.
2.07	Site Engineer	In the 1st paragraph, replace “with relevant experience” with “with at least 5 years relevant experience”. In the 2nd paragraph, replace “conduct site supervision” with “conduct full time site supervision”.
2.09	Plant and Equipment Operator	In the 1st paragraph, add “shall be in compliance with Regulation 9(3) of the Building (Demolition Works) Regulations; and” after “Operator of powered mechanical plant or equipment used in demolition work”.
2.11	Video Recording System	Replace “704 x 480” with “1920 x 1080”.
2.18	Hydraulic Concrete Crusher and Concrete Breaker	In the Sub-heading of Clause, replace “ Hydraulic Concrete Crusher ” with “ Hydraulic Concrete Crusher and Concrete Breaker ”. Combine Clauses 2.18 and 2.19.
2.19	Wrecking Ball	Add new clause “The use of swinging ball, drop ball and blasting shall not be permitted for demolition work.”.
2.22	Environmental Management Plan	Add sub-clause (vi) “The site supervisory personnel responsible for the debris management system.”.
2.27	Building Services and Drainage System	In the 1st paragraph, replace “The Contractor shall ensure that existing water supplies, drainage and building services provisions of adjacent buildings and areas will not be affected.” with “The Contractor shall appoint a Building Services Coordinator to liaise and coordinate decommissioning of existing building services installations. The Building Services Coordinator shall have a diploma or higher certificate in building services, electrical or mechanical engineering from a recognized tertiary in Hong Kong or equivalent and have at least 5 years experience in building services installations of which at least 2 years experience shall be in building services co-ordination. Ensure all existing water supplies, drainage and building services provisions of adjacent buildings and areas will not be affected.”
2.33	Safety Protection	Add “Regular inspection and clearance of debris shall be carried out” at the end of paragraph.
2.40	Clearing weeds generally	Replace “Clause 25.95 (b)” with “Clause 25.14 (b)”.
2.51	Waste disposal	In the 1st paragraph, replace "Code of Practice on Handling, Transportation and Disposal of Asbestos Wastes" with “Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste”.

Clause No.	Sub-heading of Clause	Major Changes
2.54	Regulations, Ordinances and Codes of Practice (Asbestos)	<p>In sub-clause (iv), replace ""Code of Practice on Handling, Transportation and Disposal of Asbestos Waste", Environment Protection Department, Hong Kong" with "Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste, Environment Protection Department".</p> <p>In sub-clause (v), replace "Code of Practice on Asbestos Control - Asbestos Work using Full Containment or Mini containment methods, Environment Protection Department, Hong Kong" with "Code of Practice on Asbestos Control - Asbestos Work using Full Containment or Mini Containment Method, Environment Bureau".</p> <p>In sub-clause (vi), replace "Code of Practice on Asbestos Control - Safe Handling of Low Risk Asbestos Containing Material, Environmental Protection Department, Hong Kong" with "Code of Practice on Asbestos Control - Safe Handling of Low Risk Asbestos Containing Material, Environmental Bureau".</p> <p>In sub-clause (vii), replace "Code of Practice on Asbestos Control - Asbestos Work using Glove Bag Method, Environmental Protection Department, Hong Kong" with "Code of Practice on Asbestos Control - Asbestos Work using Glove Bag Method, Environmental Bureau".</p> <p>In sub-clause (viii), replace "Code of Practice - Safety and Health at Work with Asbestos, Labour Department, Hong Kong" with "Code of Practice - Safety and Health at Work with Asbestos, Labour Department".</p>
Section 3 - Excavation and Earthwork		
3.01	Definitions	<p>In sub-clause (v)(a), replace "Rock fill" with "Rock filling material", delete "Masonry, brick and similar materials shall not be used instead of rock unless permitted by the SO." and "The rock fill shall be suitably graded for deposition and compaction in accordance with Clause 3.20."</p> <p>In sub-clause (vi)(a), replace "Rock fill" with "Rock filling material".</p> <p>Add new sub-clause (xv) "The coefficient of uniformity (C_u) shall be calculated as $C_u = D_{60}/D_{10}$ where D_{60} and D_{10} are the equivalent sieve sizes in millimetres, interpolated from the particle size distribution curve, through which 60% and 10% of the filling material would pass respectively." and new sub-clause (xvi) "The different types of filling material shall have the particle size distributions within the ranges stated in Table 3.1." after sub-clause (xiv).</p>

Clause No.	Sub-heading of Clause	Major Changes																																																						
		<p>Insert a new Table 3.1 after sub-clause (xvi) as follows:-</p> <p style="text-align: center;">TABLE 3.1</p> <p style="text-align: center;">Particle size distributions of filling material</p> <table><tr><th rowspan="3">Type of filling material</th><th colspan="6">Percentage by mass passing</th></tr><tr><th colspan="2">Size</th><th colspan="4">BS test sieve</th></tr><tr><th>400 mm</th><th>200 mm</th><th>75 mm</th><th>20 mm</th><th>600 μm</th><th>63 μm</th></tr><tr><td>Fine filling material</td><td>-</td><td>-</td><td>100</td><td>-</td><td>-</td><td>-</td></tr><tr><td>General filling material</td><td>-</td><td>100</td><td>75-100</td><td>-</td><td>-</td><td>-</td></tr><tr><td>Special filling material</td><td>-</td><td>-</td><td>100</td><td>-</td><td>-</td><td>0-45</td></tr><tr><td>Recycled rock filling material (Grade 200)</td><td>-</td><td>100</td><td>20-75</td><td>0-50</td><td>-</td><td>-</td></tr><tr><td>Rock filling material</td><td>100</td><td>20-75</td><td>10-30</td><td>0-25</td><td>-</td><td>-</td></tr></table>	Type of filling material	Percentage by mass passing						Size		BS test sieve				400 mm	200 mm	75 mm	20 mm	600 μm	63 μm	Fine filling material	-	-	100	-	-	-	General filling material	-	100	75-100	-	-	-	Special filling material	-	-	100	-	-	0-45	Recycled rock filling material (Grade 200)	-	100	20-75	0-50	-	-	Rock filling material	100	20-75	10-30	0-25	-	-
Type of filling material	Percentage by mass passing																																																							
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Recycled rock filling material (Grade 200)	-	100	20-75	0-50	-	-																																																		
Rock filling material	100	20-75	10-30	0-25	-	-																																																		
3.03	Record survey	In the 3rd paragraph, replace “by an independent surveyor included in DEVB approved list” with “by an approved independent firm included in the current List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Land, Engineering and Hydrographic Survey Services” and replace “independent surveyor” with “independent firm”.																																																						
3.04	Temporary works for earthworks	In the 1st and 2nd paragraph, replace “Temporary Works” with “temporary works”.																																																						
3.08	Generally	In sub-clause (i), replace “Temporary Works” with “temporary works”.																																																						
3.11	Tolerance for excavation	In the 1st paragraph, replace “Table 3.1” with “Table 3.2”. Replace Table No. “Table 3.1” with “Table 3.2”.																																																						
3.17	Filling	In sub-clause (v), replace “Blind the top surface of hardcore with fine filling material.” with “Blind the top surface of hardcore, recycled rock filling material and rock filling material with fine filling material.”.																																																						
3.18	Tolerance for filling	In the 1st paragraph, replace “Table 3.2” with “Table 3.3”. Replace Table No. “Table 3.2” with “Table 3.3”.																																																						
3.19	Compaction by performance specification	In sub-clause (iv)(b), replace “Table 3.5” with “Table 3.6”.																																																						
3.20	Compaction by method specification	In the 1st paragraph, replace “Adoption of the method specification for controlling compaction to be carried out only with prior approval of the SO” with “Compaction by method specification shall only be adopted for rock filling material, hardcore or general filling material with a large portion of coarse material”, add “Inspect and record compaction procedures and details carried out on site.” at the end of 1 st paragraph.																																																						

Clause No.	Sub-heading of Clause	Major Changes
		<p>Add new paragraphs “Carry out sieve analysis to determine the particle size distribution for each source of filling material. The number of tests required for each source of material shall be as stated in Table 3.5. If the results do not comply with the specified requirements, additional samples shall be provided from the same batch and additional tests shall be carried out. The number of additional samples shall be as stated in Table 3.5. If the results of the additional tests do not comply with the specified requirements, the material of the source shall not be allowed for compaction by method specification.” and “The size of samples of filling material other than rock filling material shall be in accordance with Geospec 3. Each sample of rock filling material of Grade size not exceeding 200 shall have a mass of at least 250 kg and each sample of rock filling material of Grade size exceeding 200 shall have a mass of at least 1000 kg.” after the 1st paragraph.</p> <p>In sub-clause (i), replace “Spread and level each layer of rock fill or hardcore and systematically compact by at least 12 passes of a towed vibratory roller with a minimum static load per 100 mm width of roller of 1.75 kN or a grid roller with a minimum load per 100 mm width of roller of 7.8 kN or other plant approved by the SO.” with “Compaction of rock filling material or hardcore”. Add new sub-clause (i)(a) “Spread and level each layer of rock filling material or hardcore and systematically compact by at least 12 passes of a towed vibratory roller with a minimum static load per 100 mm width of roller of 1.75 kN or a grid roller with a minimum load per 100 mm width of roller of 7.8 kN or other equivalent plant approved by the SO. Each layer of rock filling material for compaction shall not exceed 450 mm.” and sub-clause (i)(b) “The surface voids of each layer of rock filling material or hardcore shall be filled with fragments of rock before the next layer is deposited. The final surface of rock filling material or hardcore shall also be blinded with fine filling material.”</p> <p>In sub-clause (ii), replace “General filling material of which less than 90% passes a 20 mm BS test sieve shall be compacted to the following requirements:” with “Compaction of general filling material with a large portion of coarse material” in the 1st paragraph and add a new paragraph “General filling material with a large portion of coarse material shall consist of material of which less than 90% passes a 20 mm BS test sieve. It shall be compacted to the following requirements:”. Add a sub-clause (ii)(b) “The number of passes of the roller shall only be counted when the roller is travelled on the material to be compacted at a speed of not more than 2 km per hour with full vibration. Plant with addition of external load to increase the static load of the vibratory roller shall be disregarded in counting the number of passes.” after sub-clause (ii)(a).</p> <p>In sub-clause (ii)(a), replace “Table 3.3” with “Table 3.4”.</p>
		<p>Delete the 2nd paragraph “Blind the surface of rock fill or hardcore when specified with approved fine filling material.”</p> <p>Replace Table No. “Table 3.3” with “Table 3.4”.</p> <p>In Table 3.4, replace “Force per 100 mm width” with “Static Load per 100 mm width roller”.</p>
3.21	Test for determining the degree of compaction of compacted fill	<p>In sub-clause (ii), replace “Table 3.4” with “Table 3.5” and “works” with “Works” in the 2nd paragraph.</p> <p>In sub-clause (iii), replace “Table 3.5” with “Table 3.6” in the 2nd paragraph.</p>

Clause No.	Sub-heading of Clause	Major Changes																	
		<p>Rename “Table 3.4” to “Table 3.5” and replace “Number of samples for testing of optimum moisture content and maximum dry density” with “Number of samples for testing of optimum moisture content and maximum dry density of filling material and sieve analysis of the same source of filling material” in the title of the table.</p> <p>Replace Table No. “Table 3.4” with “Table 3.5”.</p> <p>In Table 3.5, replace title of the table “Number of samples for testing of optimum moisture content and maximum dry density” with “Number of samples for testing of optimum moisture content and maximum dry density of filling material and sieve analysis of the same source of filling material”.</p> <p>Replace Table No. “Table 3.5” with “Table 3.6” and replace the whole table by the new table as follows:-</p> <p style="text-align: center;">TABLE 3.6</p> <p style="text-align: center;">Number of samples for testing of moisture content and relative compaction</p> <table border="1"> <thead> <tr> <th>Description</th><th>Size of area of fill in batch</th><th>No. of samples No. of tests per batch</th></tr> </thead> <tbody> <tr> <td rowspan="3">Areas of fill in excavations for structures, pits and trenches and on formations</td><td>less than 100 m²</td><td>3</td></tr> <tr> <td>100 – 500 m²</td><td>2 for each 100 m² or part thereof</td></tr> <tr> <td>more than 500 m²</td><td>1 for each 100 m² or part thereof</td></tr> <tr> <td rowspan="3">Areas of fill other than in excavations for structures, pits and trenches and on formations</td><td>less than 1 ha</td><td>4 for each 1000 m² or part thereof</td></tr> <tr> <td>1 - 10 ha</td><td>3 for each 1000 m² or part thereof</td></tr> <tr> <td>more than 10 ha</td><td>2 for each 1000 m² or part thereof</td></tr> </tbody> </table> <p>Note: For the purpose of testing moisture content and relative compaction, a batch is any quantity of filling material which is of the same type and which is deposited in a single layer in any one location of fill presented by the Contractor for testing on one occasion.</p> <p>Formation is that part of the earthworks final surface on which a pavement, structure or utility, is constructed, or on which the blinding or bedding for a pavement, structure or utility is placed.</p>	Description	Size of area of fill in batch	No. of samples No. of tests per batch	Areas of fill in excavations for structures, pits and trenches and on formations	less than 100 m ²	3	100 – 500 m ²	2 for each 100 m ² or part thereof	more than 500 m ²	1 for each 100 m ² or part thereof	Areas of fill other than in excavations for structures, pits and trenches and on formations	less than 1 ha	4 for each 1000 m ² or part thereof	1 - 10 ha	3 for each 1000 m ² or part thereof	more than 10 ha	2 for each 1000 m ² or part thereof
Description	Size of area of fill in batch	No. of samples No. of tests per batch																	
Areas of fill in excavations for structures, pits and trenches and on formations	less than 100 m ²	3																	
	100 – 500 m ²	2 for each 100 m ² or part thereof																	
	more than 500 m ²	1 for each 100 m ² or part thereof																	
Areas of fill other than in excavations for structures, pits and trenches and on formations	less than 1 ha	4 for each 1000 m ² or part thereof																	
	1 - 10 ha	3 for each 1000 m ² or part thereof																	
	more than 10 ha	2 for each 1000 m ² or part thereof																	
3.23	Embankments	In sub-clause (v), replace “Clause 3.20” with “Clause 3.20(i)”.																	

Clause No.	Sub-heading of Clause	Major Changes
Section 4 - Steel Sheet Piling Work		
4.17	Re-use steel sheet pile from other site	<p>Add two paragraphs “For steel sheet piles re-used as temporary works with design prepared by the contractor that require checking and certification by independent checking engineer or structural design checker, mill certificate and testing requirements of steel sheet piles may be exempted by the independent checking engineer or structural design checker who shall provide justifications to the SO for prior agreement.” and</p> <p>“For other steel sheet piles re-used as temporary works, steel sheet piles may be re-used without testing, subject to contractor’s provision of adequate proof evidence, e.g. mill certificate or testing certificate of structural steel materials, etc., showing that the steel sheet piles are in compliance with the specification.” after the 1st paragraph.</p>
Section 5 - Piling Work		
5.01	General	<p>Delete sub-clause (ii)(g) “Hand dug caissons”</p> <p>Re-number sub-clauses (ii)(h) – (k) to (ii)(g) – (j).</p> <p>In sub-clause (ii)(h), add “(RSSHP)” after “Rock-socketed Steel H-piles”.</p> <p>In sub-clause (v)(a) & (v)(b), replace “soil and water load” with “adverse soil and water load”.</p> <p>In sub-clause (v), replace the NOTE “The theoretical safe loading capacity of piles in this case” with “The allowable load capacity of piles in the load case with wind load”.</p> <p>In sub-clause (xi), delete “Group I and Group II of”.</p>
5.02	Design submission	<p>In sub-clause (i)(a), replace “A full specification of the piles proposed. Piles of the same size and material shall be designed and constructed to the same safe loading capacities irrespective of the actual design load sustained by each pile. Should the Contractor design the pile by adopting a theoretical safe loading capacity of pile less than the maximum value allowed in this specification, this lower theoretical safe loading capacity shall be used for the purpose of static loading test.” with “A full specification of the piles proposed. Piles of the same size and material shall be designed and constructed to the same allowable load capacities irrespective of the actual design load sustained by each pile. Should the Contractor design the pile by adopting a smaller allowable load capacity of pile, the adopted allowable load capacity shall be used for calculating the test load for the static loading test.”</p> <p>In sub-clause (i)(b), add “The load to be taken by each pile during the life of the superstructure shall not exceed the allowable load capacity of the pile.” at the end of the paragraph.</p> <p>Delete sub-clauses (i)(c) & (i)(d).</p> <p>Replace sub-clause no. “(i)(e)” with “(i)(c)”.</p> <p>Add a new sub-clause (i)(d) as follows:- “A method of installation including equipment to be used, sequence of operations, quality supervision and site control measures.”</p>

Clause No.	Sub-heading of Clause	Major Changes												
		<p>Delete sub-clauses (ii).</p> <p>In sub-clause (iii), replace “Obtain the agreement of the SO in writing to the matters referred to in items (i) and (ii) above before work commences....” with “Obtain the agreement of the SO in writing to the matters referred to in item (i) above before work commences....”</p> <p>Add a new paragraph in sub-clause (iv)(b) as follows:- “The drawing presentation shall comply with the Drafting Manual for Reinforced Concrete Structures for Architectural Services Department.”</p> <p>In sub-clause (vi)(b), replace “theoretical safe loading“ with “allowable load”.</p> <p>Re-number sub-clauses (iii) – (vi) to (ii) – (v).</p>												
5.03	Provision of drawings and calculations	<p>In sub-clause (ii), replace the 2nd paragraph “The survey shall be carried out jointly by the Contractor and an Independent Surveyor employed by the Contractor at his own cost. The Independent Surveyor shall be registered with the Hong Kong Institute of Surveyors. These as-built piling record drawings shall be certified by both the Contractor and the Independent Surveyor.” with “The survey shall be carried out jointly by the Contractor and an approved independent firm included in the current List of Approved Suppliers of Materials and Specialist Contractors for Public Works – Land, Engineering and Hydrographic Survey Services employed by the Contractor at his own cost. These as-built piling record drawings shall be certified by both the Contractor and the independent firm.”</p> <p>In sub-clause (iii), replace “Independent Surveyor“ with “independent firm”.</p>												
5.04	Loading capacity of piles	<p>Replace the title “Loading capacity of piles” with “Allowable load capacity of piles”.</p> <p>In sub-clauses (i) – (iii), replace “theoretical safe loading” with “allowable load”.</p> <p>In sub-clause (i), delete “or the cross-sectional area of the caisson not including the lining”.</p> <p>Replace TABLE 5.1 as follows:</p> <p style="text-align: center;">Minimum yield stress with thickness</p> <table border="1"> <tr> <th>Steel Specification</th><th>Up to and including 16 mm</th><th>Over 16 mm Up to and including 40 mm</th></tr> <tr> <td>BS EN 10025 -Grade S275</td><td>275 MPa</td><td>265 MPa</td></tr> <tr> <td>BS EN 10025 -Grade S355JR</td><td>355 MPa</td><td>345 MPa</td></tr> <tr> <td>BS EN 10025 -Grade S450J0</td><td>450 MPa</td><td>430 MPa</td></tr> </table>	Steel Specification	Up to and including 16 mm	Over 16 mm Up to and including 40 mm	BS EN 10025 -Grade S275	275 MPa	265 MPa	BS EN 10025 -Grade S355JR	355 MPa	345 MPa	BS EN 10025 -Grade S450J0	450 MPa	430 MPa
Steel Specification	Up to and including 16 mm	Over 16 mm Up to and including 40 mm												
BS EN 10025 -Grade S275	275 MPa	265 MPa												
BS EN 10025 -Grade S355JR	355 MPa	345 MPa												
BS EN 10025 -Grade S450J0	450 MPa	430 MPa												
5.05	Settlement characteristics of piles	<p>Replace “the formula in Clause 5.28 (iv)” with “the formula in Clause 5.29 (iv)”.</p>												

Clause No.	Sub-heading of Clause	Major Changes
5.06	Negative skin friction	In sub-clause (i), replace “The design calculations” with “The pile design calculations”. In sub-clause (ii), replace “for approval.” with “for SO’s approval.” at the end of the paragraph.
5.07	Pile group reduction factor	In the 1st paragraph, replace “safe working loads” with “allowable load capacity”. In sub-clause (ii), replace “loading capacity” with “allowable load capacity”.
5.08	Minimum spacing / nos. of piles	Replace the whole sub-clause (ii) by the new sub-clause (ii) as follows:- “For piles bearing on bedrock as defined in Clause 5.19 (iv), the minimum clear spacing between the shaft surfaces of adjacent piles or edge of bell-outs shall be 1000 mm.” Replace the whole sub-clause (iii) by the new sub-clause (iii) as follows:- “The centre to centre spacing of piles shall not be less than 750mm or 2 times the outer diameter, whichever is the greater for minipiles and the perimeter of the drill hole formed in bedrock for RSSHP.” Sub-clause (iv) deleted. Re-number sub-clauses (v) – (vii) to (iv) – (vi).
5.10	Investigation for positions of piles	In sub-clause (ii), replace “drawings to demonstrate that any revision to the pile cap layout submitted in accordance with Clause 5.02 (i)(e) is the practical minimum” with “drawings to demonstrate that any revision to the pile cap layout submitted in accordance with Clause 5.02 (i)(c) is the practical minimum”.
5.13	Energy reduction factor for followers	In sub-clause (iii), replace “Dynamic pile test” with “Dynamic Pile Test (DPT)”.
5.14	Percussion piles	In sub-clause (i), replace “safe loading capacity” with “allowable load capacity”. In sub-clause (ii), replace “Where it can be demonstrated by PDA analysis that the driving stress at final set is greater than 0.6fy for steel H-piles, the design final penetration may be taken as not less than 1.0 mm per blow.” with “Where it can be demonstrated by DPT that the driving stress at final set is greater than 2 times the design working compressive stress for the allowable load capacity of the pile for steel H-piles, the design final penetration may be taken as not less than 1.0 mm per blow.” and replace “theoretical safe loading capacity” with “allowable load capacity”. In sub-clause (iii), replace “loading capacity” with “allowable load capacity”.

Clause No.	Sub-heading of Clause	Major Changes
		<p>Replace the whole sub-clause (iv) by the new sub-clause (iv) as follows:- “The efficiency of the hammer (Eh) and the coefficient of restitution of the hammer cushion (e) shall be determined from/verified by carrying out Dynamic Pile Test (DPT) and CAPWAP analysis on trial piles (at least 5 piles for each hammer – pile size – drop height combination). Separate set of trial piles shall be carried out for founded piles with length difference exceeding 20m. For steel H-piles, the protruded length of all trial piles above ground shall not be greater than 3m and the measured driving stress of all trial piles in DPTs shall be greater than 2 times the design working compressive stress for the allowable load capacity of the pile as demonstrated with DPTs, and the 90% CAPWAP capacity of each trial pile shall not be less than twice the allowable load capacity of the pile. The combination of Eh and e shall be so chosen such that when these values are substituted into the Hiley Formula, the average of the predicted load capacity of the trial piles is not higher than 90% of the average CAPWAP capacity. If the measured driving stress at final set or 90% CAPWAP capacity requirements of each pile are not satisfied, the allowable load capacity of the piles shall be reduced and submitted for SO’s approval.”</p> <p>Replace the whole sub-clause (v) by the new sub-clause (v) as follows:- “If reasonable values of design final set (not less than 2.5 mm or 1.0 mm per blow as the case may be) cannot be obtained from the Hiley Formula with Eh and e so chosen and subject to the approval of the SO, all the piles falling into this category shall be subject to DPT and the allowable load capacity of the piles shall be assessed by CAPWAP analysis. For steel H-piles, the measured driving stress of the piles in DPTs shall be greater than 2 times the design working compressive stress for the allowable load capacity of the pile as demonstrated with DPTs. The pile shall not be considered to have attained the allowable load capacity should the 90% CAPWAP capacity is less than twice the allowable load capacity. In addition to the loading test requirements in Clause 5.29, the SO shall select 1% of nos. of piles (minimum one number) for each batch of piles proposed by the Contractor for phased completion to be load tested for acceptance. All the time and cost incurred from the DPTs, CAPWAP analyses and the additional loading tests shall be borne by the Contractor. Employ an Accredited Laboratory to carry out and interpret the DPTs, CAPWAP analyses and the additional loading tests. The Accredited Laboratory shall submit HOKLAS endorsed test reports directly to the SO in sealed envelopes within 14 days of the completion of the testing.”</p> <p>In sub-clause (vii), add “In any case, a minimum of 20 blows of the same driving energy as at the previous final set shall be required before final set is taken. Such requirement might be waived unless it can demonstrate that the driving stress at the pile exceeds 0.9fy.” after the end of the paragraph.</p> <p>In sub-clause (viii), replace “If the protruding length of the pile above ground is more than 3m during the final set measurement, the temporary compression above ground level (Cp+Cq) in the approved final set table shall be increased by 1mm per each metre increase beyond 3m.” with “If the protruding length of the pile above ground is more than 3m during the final set measurement, the measured temporary compression (Cp+Cq) shall be increased by 1mm per each metre increase beyond 3m.”</p>

Clause No.	Sub-heading of Clause	Major Changes
		Replace the whole sub-clause (ix) by the new sub-clause (ix) as follows:- “The piles selected for DPTs (restrike test) shall be tested under the same driving conditions as in the final set measurement, i.e. same hammer, same hammer drop height and total length of pile not less than that at final set measurement. The set penetration of at least 10 blows shall be recorded and the measured driving stress of the piles shall be greater than 2 times the design working compressive stress for the allowable load capacity of the pile during the DPTs. If the measured final set values of the piles during the DPTs are more than that during the final set measurement, the allowable load capacity of these piles shall be assessed by CAPWAP analysis. All the time and cost incurred from CAPWAP analysis shall be borne by the Contractor.”
5.16	Precast prestressed tubular piles	In sub-clause (iii), replace “Clause 5.18(v)” with “Clause 5.18(vi).
5.18	Steel ‘H’ piles	<p>Insert new sub-clause (iii) “Testing of steel sections and accessories shall be as Section 15 – Structural Steel Work.” and re-number sub-clauses (iii) - (vi) to (iv) to (vii).</p> <p>In sub-clause (iii), replace “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 site by the SO for testing.” with “Notwithstanding Clause 5.18(iii), 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 site by the SO for testing.”.</p> <p>In sub-clause (iv), replace “PDA analysis” with “DPT”.</p> <p>Insert new sub-clause (viii) “Unless otherwise specified, inspection and testing of welding, other than those shown on the typical splicing details and pile head details shown in Annex “B” and “C”, shall be in accordance with Clause 15.58.” and re-number sub-clauses (vii) - (viii) to (ix) to (x).</p> <p>In sub-clause (viii), replace “loading capacity” with “allowable load capacity”.</p>
5.19	Large diameter bored piles	<p>In sub-clause (ii), delete “Group I and Group II of” and add the sentence “Rock specimens shall be taken at top, middle and bottom along the length of rock core samples for point load test to determine the uniaxial compressive strength (UCS) of rock.” before the last sentence.</p> <p>Replace the whole sub-clause (iv) by the new sub-clause (iv) as follows:- (iv) Bedrock is defined as rock mass of at least 5 m thick and being Grade III or better rock (as defined in GEOGUIDE 3, “Guide to Rock and Soil Descriptions” prepared by Geotechnical Engineering Office and published by GIS, Hong Kong).</p> <p>For design purposes, the maximum bearing pressure of piles on bedrock shall not exceed the following:</p> <ul style="list-style-type: none"> (a) 3 MPa for Grade III or better rock with total core recovery greater than 50% for any one metre within the rock mass. (b) 5 MPa for Grade III or better rock with total core recovery greater than 85% for any one metre within the rock mass and minimum uniaxial compressive strength (UCS) not less than 25 MPa (equivalent point load index strength PLI50 not less than 1 MPa).

Clause No.	Sub-heading of Clause	Major Changes
		<p>(c) 7.5 MPa for Grade II or better rock with total core recovery greater than 95% for any one metre within the rock mass and minimum uniaxial compressive strength (UCS) not less than 50 MPa (equivalent point load index strength PLI50 not less than 2 MPa).</p> <p>The point load index strength of rock is the equivalent value for 50 mm diameter cores.</p> <p>Replace the whole sub-clause (v) by the new sub-clause (v) as follows:- “Do not use piles with enlarged bases unless specified otherwise. Where so permitted, the Particular Specification for Large Diameter Bored Piles with bell-out shall be referred to. The relevant technique shall have been approved by the Development Bureau.”</p> <p>In sub-clause (xi), add the phrase “as approved by the SO” at the end of the 1st paragraph. In the 2nd paragraph, replace “for approval” with “for SO’s approval”.</p> <p>In sub-clause (xiii), replace “contractor” with “Contractor”.</p>
5.21	Hand dug caissons	Delete the whole Clause for “Hand dug caissons” and add a new Clause 5.21 for “Minipiles”.
5.22	Tolerances in setting out of piles	<p>Re-number Clause 5.22 to Clause 5.23 and add a new Clause 5.22 for “Rock-socketed Steel H-piles”.</p> <p>In sub-clause (ii)(a), add “Rock-socketed steel H piles” and delete “Hand dug caissons”.</p> <p>In sub-clause (iii)(a), add “Rock-socketed steel H piles”.</p> <p>In sub-clause (iii)(b), delete “Hand dug caissons”.</p> <p>In sub-clause (iv), replace “Clause 5.24(i)” with “Clause 5.25(i)” at the end of the paragraph.</p> <p>In sub-clause (v), replace “Submit proposals for remedial works, if necessary, to the SO for agreement within 10 days after the completion of the said survey.” with “Submit remedial proposals for piles exceeding construction tolerances for SO’s approval within 10 days after the completion of the said survey.”</p>
5.23	Effect of vibration on adjacent structures and services	<p>Re-number Clause 5.23 to Clause 5.24.</p> <p>In sub-clause (iii), replace “Clause 5.23(ii) above will apply” with “Clause 5.24(ii) above will apply” at the end of the paragraph.</p>
5.24	Cutting off pile heads	<p>Renumber clause 5.24 to clause 5.25.</p> <p>In sub-clause (v)(a), delete “and caissons”.</p>
5.25	Pile caps tie beams and dowel bars	<p>Re-number Clause 5.25 to Clause 5.26 and replace the title “Pile caps tie beams and dowel bars” with “Pile caps, tie beams and dowel bars”.</p> <p>In sub-clause (i), replace “Unless otherwise specified, pile caps are part of the Works” with “Unless otherwise specified, pile caps, strap and tie beams are part of the Works”.</p>

Clause No.	Sub-heading of Clause	Major Changes
		In sub-clause (ii)(a), replace “All pile caps and strap beams” with “All pile caps, strap and tie beams” in the 1st paragraph.
5.26	Backfilling	Re-number Clause 5.26 to Clause 5.27.
5.27	Report sheets	<p>Re-number Clause 5.27 to Clause 5.28.</p> <p>Delete the whole sub-clause (v).</p> <p>Re-number sub-clause (vi) to (v) and replace the title “Mini pile” with “Mini-pile/Rock-socketed Steel H pile”.</p> <p>In sub-clause (v)(j), replace “Drilling rates and material encountered” with “Drilling rates, compressed air pressure and material encountered”.</p> <p>In sub-clause (v)(q), add “for Mini-pile; or length of steel H-pile for RSSHP.”</p>
5.28	Loading tests	<p>Re-number Clause 5.28 to Clause 5.29.</p> <p>In sub-clause (i), delete “and caissons” and replace “theoretical safe loading capacity” with “allowable load capacity”.</p> <p>In sub-clause (ii), replace “theoretical safe loading capacity” with “allowable load capacity”.</p> <p>Replace the whole sub-clause (iv) by the new sub-clause (iv) as follows:- A total settlement or residual settlement in excess of that calculated from the formulae below shall be deemed to be failure to satisfy the settlement criterion in the loading test.</p> <div style="margin-left: 40px;"> <p>Total Settlement = $d + D/120 + 4 \text{ mm}$</p> <p>Residual Settlement = $D/120 + 4 \text{ mm}$; and 25% of the maximum pile head settlement during the test, whichever is the greater.</p> <p>where:</p> <p>d = PL/AE</p> <p>D = Diameter of circular pile in mm, or = The least lateral dimension of steel 'H' pile section in mm (for driven steel 'H' pile) = Outer diameter of steel casing for Minipile, or = Diagonal of rectangle enclosing H-section for RSSHP)</p> <p>P = Test load</p> <p>L = Nett length of pile (For piles with rock sockets, L shall be measured to the centre of the rock socket.)</p> <p>A = Cross sectional area of pile, or = Transformed section comprising casing, grouting and rebars for Minipile, or = Cross sectional area of steel 'H' pile for RSSHP</p> <p>E = Young's modulus of pile given below:</p> </div>

Clause No.	Sub-heading of Clause	Major Changes
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Clause No.	Sub-heading of Clause	Major Changes																																			
5.34	Preparation of piles for non-destructive integrity testing generally	Re-number Clause 5.34 to Clause 5.35.																																			
5.35	Preparation for piles for Sonic Logging	Re-number Clause 5.35 to Clause 5.36. In sub-clause (vii), replace “Clause 5.35(i)” with “Clause 5.36(i)” in the 1st sentence.																																			
5.36	Prepare piles for Integrity Testing	Re-number Clause 5.36 to Clause 5.37.																																			
5.37	Prepare piles for Dynamic Testing	Re-number Clause 5.37 to Clause 5.38.																																			
Annex E	Typical Detail of Caisson	Replace the whole Annex E “Typical Detail of Caisson” with a new Annex E “Typical Shear Bars Details for Rock-Socketed Steel H-Pile”.																																			
Section 6 - Structural Concrete Works																																					
6.17	Test specimens	<p>Replace sub-clause (vi) with “For fabric reinforcement, provide one sample from each batch for testing. The size of each batch shall not exceed 50 tonnes”.</p> <p>Delete sub-clauses (viii), (xi), (xii) and, (xiv).</p> <p>Re-number sub-clauses (ix), (x), (xiii) and (xv) as sub-clauses (viii) to (xi), following numerical sequence.</p> <p>Replace table in sub-clause (ix) as follows:</p> <table><tr><th rowspan="2">Description</th><th colspan="5">Type and number of tests</th></tr><tr><th>Tensile</th><th>Rebend</th><th>Unit Mass</th><th>Weld Shear Stress</th><th>Pitch Dimension</th></tr><tr><td>Steel fabric</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>- fabric sheet</td><td>-</td><td>-</td><td>2 ^(a)</td><td>2</td><td>-</td></tr><tr><td>- longitudinal wire</td><td>3</td><td>1</td><td>-</td><td>-</td><td>1</td></tr><tr><td>- transverse wire</td><td>3</td><td>1</td><td>-</td><td>-</td><td>1</td></tr></table> <p>^(a) One sample for the longitudinal direction and one for the transverse direction</p> <p>Replace sub-clause (x) with “If the result of any test for yield stress, tensile strength, elongation, weld shear strength, rebend, unit mass or pitch dimension does not comply with the specified requirements for the property, two additional test specimens shall be provided from different reinforcement of the same batch and additional tests for the property shall be carried out”</p> <p>Add to end of sub-clause (xi) “The non-complying batch of fabric reinforcement shall be removed from the Site.”</p>	Description	Type and number of tests					Tensile	Rebend	Unit Mass	Weld Shear Stress	Pitch Dimension	Steel fabric						- fabric sheet	-	-	2 ^(a)	2	-	- longitudinal wire	3	1	-	-	1	- transverse wire	3	1	-	-	1
Description	Type and number of tests																																				
	Tensile	Rebend	Unit Mass	Weld Shear Stress	Pitch Dimension																																
Steel fabric																																					
- fabric sheet	-	-	2 ^(a)	2	-																																
- longitudinal wire	3	1	-	-	1																																
- transverse wire	3	1	-	-	1																																

Clause No.	Sub-heading of Clause	Major Changes
6.34	Grading of aggregates	Delete Tables 6.3, 6.4 and 6.5 (which are not used).
6.35, 6.40, 6.41, 6.42, 6.42.3, 6.45, 6.46, 6.54, 6.55, 6.56, 6.60, 6.62 and 6.68		Within the clauses and sub-clauses, re-number Tables 6.6 to 6.16 as Tables 6.3 to 6.13, following numerical sequence.
6.35	Water	In sub-clause (iii) & (iv), replace “Table 6.15” with “Table 6.12”.
6.40	Generally	In the 4th & 5th paragraph, replace “Table 6.8” with “Table 6.5”.
6.41	Standard mixes	In the 1st paragraph, replace “Table 6.6 and Table 6.7” with “Table 6.3 and Table 6.4”. Replace Table No. “6.6” with “6.3” and “6.7” with “6.4”.
6.42	Designed mixes	In the 1st paragraph, replace “Table 6.8” with “Table 6.5”.
6.42.3	20% recycled coarse aggregates	In sub-clause (iii) & (iv), replace “Table 6.16” with “Table 6.13”. Replace Table No. “6.8” with “6.5”.
6.43.5	Approved concrete mix	After first paragraph, insert new paragraph as follows: “Notwithstanding the above, the cementitious content of the approved concrete mix may be varied during routine production by an amount not exceeding 20 kg/m ³ , provided that the specified limits for cementitious content are maintained.”
6.45	Chloride content	In the 1st paragraph, replace “Table 6.9” with “Table 6.6”. Replace Table No. “6.9” with “6.6”.
6.46	Workability	In the 1st paragraph, replace “Table 6.8” with “Table 6.5” and “Table 6.10” with “Table 6.7”. Replace Table No. “6.10” with “6.7”.
6.54	Sampling of fresh concrete	In the 1st paragraph, replace “Table 6.11” with “Table 6.8”. Replace Table No. “6.11” with “6.8”. In the re-numbered Table 6.8, replace “Approximate quantity of concrete to be represented by each sample (from non QSPSC supplier)” with “Approximate quantity of concrete to be represented by each sample”.
6.55	Concrete cubes	For sub-clause (ii) Designed mixes, in sub-clause (b), (c)(1) & (c)(2), replace “Table 6.12” with “Table 6.9”. Replace Table No. “6.12” with “6.9”. In the re-numbered Table 6.9, add “at least” to end of title of Column A. Replace sub-clause (iv) as follows: - “If the calculated standard deviation exceeds 5.5 MPa for 100 mm test cubes or exceeds 5 MPa 8 MPa for 150 mm test cubes, compliance requirement C1 shall apply to subsequent test results.”

Clause No.	Sub-heading of Clause	Major Changes
		<p>Replace sub-clause (v) as follows: -</p> <p>“When the following situation occurs, no further concrete shall be placed in the permanent works until an investigation of the materials, mix design, methods of production, sampling and testing has been carried out and measures, which in the opinion of the SO will result in restoring a satisfactory standard of quality control, have been taken:</p> <p>(a) For concrete of grades between 20D and not exceeding grade 60D, the calculated standard deviation exceeds 8.5 MPa for 100 mm test cubes or 8 MPa for 150 mm test cubes; or</p> <p>(b) For concrete grade exceeding 60D, the coefficient of variation as calculated after every 40 test results, exceeds 14%.”</p>
6.56	Workability	In sub-clause (i), replace “Table 6.6” with “Table 6.3”.
6.60	Failures	In sub-clause (i), replace “Table 6.6” with “Table 6.3”.
6.62	Workmanship	<p>In the 5th paragraph, replace “Table 6.13” with “Table 6.10”.</p> <p>Replace Table No. “6.13” with “6.10”.</p>
6.68	Lintels	<p>In the 1st paragraph, replace “Table 6.14” with “Table 6.11”.</p> <p>Replace Table No. “6.14” with “6.11”.</p>
Section 8 – Concrete for minor and Non-Structural Works		
8.22	Prescribed mix concrete with 100% recycled coarse aggregates	Replace Table No. “6.16” with “6.13”.
Section 9 - Brickwork and Blockwork		
9.01	Generally	Replace “BS EN 1996-36” with “BS EN 1996-3”.
9.03	Facing bricks	Replace “ASTM C216-11” with “ASTM C216-16”.
9.22	Proportion	In sub-clause (c)(iii), replace “BS4551+A1” with “BS 4551+A2”
9.26	Samples of face brickwork and blockwork	Replace “1 m ² ” with “1 m²”
9.39	Finishing of joints	In the first paragraph, replace “to provide a smooth surface flush with the brick or block face” with “to provide a smooth surface with the brick or block face or with details as approved”.

Clause No.	Sub-heading of Clause	Major Changes
Section 10 - Masonry		
10.06	Wall ties	<p>Replace “Ties between walls and concrete shall be copper, bronze or stainless steel and shall be to BS EN 845-1+A1” with “Ties between walls and concrete shall be 20x3mm stainless steel 316 flats 350 mm long, fanged at both end and shall be to BS EN 845-1+A1”.</p> <p>Add “Ties for walls built against face of concrete to be formed from 20x3 mm stainless steel 316 flats 150 mm long, fanged at both ends and shall be to BS EN 845-1+A1.”</p>
10.20	Pointing ashlar walling	Replace “shall be pointed with a flush joint on completion using bedding mortar” with “shall be finished with a weathered or recessed joint as specified on completion using bedding mortar”
Section 12 – Roofing		
12.99	Generally	Add “approved by the manufacturers/agents” at the end of the paragraph.
12.119	Warranty	Delete “by the Contractor” and “as an exposed roof membrane”
Section 14 - Ironmongery		
		Add sub-heading “GENERALLY” under ARCHITECTURAL IRONMONGERY.
14.04	Standard	In the 1st paragraph, replace “International Standards” with “National Standards”.
		Replace “ BS EN 179 Emergency exit devices” with “ 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”.
		Add “ BS EN 573-5 Aluminium and aluminium alloys. Chemical composition and form of wrought products. Codification of standardized wrought products” after BS EN 573-3 .
		<p>Replace “BS EN 1634-1 to 3 Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware” with:</p> <p>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”.</p> <p>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”.</p> <p>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”.</p>

Clause No.	Sub-heading of Clause	Major Changes			
14.05	Certification	Add “Door ironmongery” as section heading.			
14.06	Certification for fire door	Delete “,” after “the Works”.			
14.10	Compatibility	Replace “from one source” with “from approved reputable source.”.			
14.13	Keys	In the 2nd paragraph, add “,” after “when master keying is specified”.			
14.24	Hinges and pivots	Add long term “screw gauge” for SG.			
14.31	Overhead door closers	Replace “ABHM” with “The Door & Hardware Federation (DHF)”.	Replace “Hardware for Timber Fire and Escape Doors" with “Hardware for Fire and Escape Doors".		
14.48	Floor springs	In table 1 recommended door leaf width, replace “Nm max” with “mm max”.	Delete underline under the figures in the table.		
14.58	Locks	Replace “from a single reputable source” with “from an approved reputable source”.			
14.94	Sundries	Replace “Ironmongery to sundries” with “Ironmongery sundries”.			
14.100	Fittings to drawers and cupboards	Add “FURNITURE IRONMONGERY” as sub heading.			
Section 15 – Structural Steel Work					
15.48	Welding consumables	In the 1st paragraph, replace “BS EN 499”, “BS EN 440”, “BS EN 756” and “BS EN 758” with “BS EN ISO 2560”, “BS EN ISO 14341”, “BS EN ISO 14171” and “BS EN ISO 17632” respectively.			
15.58	Acceptance of welds	In the 3rd paragraph, replace “BS EN 970” with “BS EN ISO 17637”.	In the 5th paragraph, replace “BS EN 1290” with “BS EN ISO 17638” and “BS EN 571” with “BS EN ISO 3452-1”.	In the 6th paragraph, replace “BS EN 1714” with “BS EN ISO 17640”.	In Table 15.6, replace “All types of butt welds” with “Full penetration butt welds with maximum thickness of the parent material exceeding and including 8 mm”, add new rows “Full penetration butt welds with maximum thickness of the parent material not exceeding 8 mm.” “100% magnetic particle inspection”, “Partial penetration butt welds with depth of penetration exceeding and including 8 mm.” “100% ultrasonic examination and magnetic particle inspection” and “Partial penetration butt welds with depth of penetration not exceeding 8 mm.” “100% magnetic particle inspection”.

Clause No.	Sub-heading of Clause	Major Changes
Section 16 - Curtain Walls		
16.05	Ordinances, Regulations, Codes and standards	<p>In the 1st paragraph, add “as defined in Index 4, regarding Ordinances, Regulations, Code of Practices, Standards and PNAP relevant for Curtain Walls and Glazing under Section 16 and Section 20” after “in this Specification”.</p> <p>In the Sub-heading of Clause, add “Ordinances, Regulations,” before “Codes and standards”.</p> <p>Delete sub-clause (i) to (xv).</p>
16.06	Contractor's design responsibility	In sub-clause (v), replace “for live load deflection of the slab and inter-storey drift” with “for imposed load deflection of the slab and inter-storey drift”.
16.07	Tender submission	Not used.
16.09	Provision of drawings and calculations	In sub-clause (i)(m), replace “ BS 499-2C and BS EN 22553 ” with “ BS 499-2C and BS EN ISO 2553 ”.
16.18	Fastener	In sub-clause (ii), replace “ BS EN ISO 3506 ” with “ BS EN ISO 3506-1 and BS EN ISO 3506-2 on Mechanical properties for corrosion- resistant stainless steel fasteners ”.
16.23	Operable windows	In the 1st paragraph, replace “ BS 4873 and BS 6375 ” with “ APP-116, BS 4873, BS 6375-1+A1, BS 6375-2 and BS 6375-3+A1 ”.
16.24	Composite and honeycomb panels	In sub-clause (ii)(c), replace “Core shall be polyethylene or similar” with “Core shall be entirely of non-combustible materials which meet the requirements of BS 476-4 or BS EN 13501-1 Class A1 ”.
16.32	Organic coating finish to aluminium	In the 3rd paragraph, replace “ BS 6496 ” with “ BS EN 12206-1 ”.
16.39	Welding	In the 3rd paragraph, replace “ BS EN ISO 4136 - Destructive tests on welds in metallic materials. Transverse tensile test, BS EN ISO 5173 - Destructive tests on welds in metallic materials. Bend tests, BS EN 1320 - Destructive tests on welds in metallic materials. Fracture tests, BS EN 1321 - Destructive test on welds in metallic materials. Macroscopic and microscopic examination of welds” with “ BS EN ISO 4136 Destructive tests on welds in metallic materials - Transverse tensile test, BS EN ISO 5173 Destructive tests on welds in metallic materials - Bend tests, BS EN 1320 Destructive tests on welds in metallic materials - Fracture tests and BS EN 1321 Destructive test on welds in metallic materials - Macroscopic and microscopic examination of welds”.
16.46	Structural requirements	In sub-clause (i), add “and APP-139 ” after “Code of Practice on Wind Effects in Hong Kong”.
16.58	Condensation gutters	Add paragraph “The design and installation of the condensation gutters shall follow BS 5250+A1 Code of Practice for Control of Condensation. ” after the 1st paragraph.
16.63	Criteria for painted finishes	In sub-clause (i), replace “ BS 6496 ” with “ BS EN 12206-1 ”.

Clause No.	Sub-heading of Clause	Major Changes
16.66	Criteria for operable window	In sub-clause (i), replace “ BS4873 and BS 6375 ” with “ BS 4873, BS 6375-1+A1, BS 6375-2 and BS 6375-3+A1 ”.
16.70	Fire resistance	<p>Add “Curtain wall, which protects the building against the elements and which extends beyond one storey in height, should be constructed entirely of non-combustible materials (except for window sealants and gaskets) according to Code of Practice for Fire Safety in Buildings.” at the beginning of paragraph.</p> <p>Replace “the panels of the curtain wall shall be completely sealed up with fire resistant material to provide a 2 hour resistant period against fire and smoke” with “the panels of the curtain wall shall be completely sealed up with fire resistant material, having an Fire Resistance Rating (FRR) of not less than that of the floor slabs, against fire and smoke”.</p> <p>Replace “BS 476:” with “BS 476-4 for External Curtain Wall System”.</p>
16.77	Laboratory tests of stone	Replace sub-clause no. “(i)” with “(xii)”.
16.78	Test reports	In the 1st paragraph, replace “ BS 5368:Pt.4 ” with “ BS 5368-4 ”.
Section 17 – Metal Work		
17.05	Slotted steel angle	<p>Delete “to BS 4345”.</p> <p>Replace “cadmium plated” with “stainless”.</p>
17.12	Adhesive for metal	Add paragraph “The VOC content of adhesive shall not exceed the maximum VOC content limits as stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation (Cap.311W).” after the 1st paragraph.
17.21	Finishing to steel	In sub-clause (d), delete “with a minimum thickness of 85µm”.
17.23	Chromium plating	Add paragraph “Hexavalent chromium plating shall not be applied to window components.” after the 1st paragraph.
17.33	Aluminium windows and doors	<p>In sub-clause (j), replace “Use stainless steel, galvanized or cadmium-plated steel for” with “Use stainless steel or galvanized steel for”.</p> <p>In sub-clause (k)(iii), delete “cadmium plated steel with”.</p> <p>In sub-clause (k)(v), replace “cadmium plated steel with nylon” with “stainless steel”.</p>
17.42	Fire resisting shutters	Replace “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 476 :parts 20 to 24.” by “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 :parts 20 to 24.”
17.45	Sealant for metal	Add a new clause “The VOC content of sealant shall not exceed the maximum VOC content limits as stipulated in the Air Pollution Control (Volatile Organic Compounds) Regulation (Cap. 311W).” after the Clause 17.44 .

Clause No.	Sub-heading of Clause	Major Changes
Section 18 - Finishes		
18.03	Sand	In Table 18.1, replace “shall be clean natural sand free from salt” with “shall be clean sand free from salt”.
18.184	Non-slip homogenous floor ties	In sub-clause “d”, replace “Static Coefficient of Friction for wet surface” with “Anti-slip property”, “ASTM - C1028 – 07” with “DIN 51130” and “> = 0.5” in column “Acceptance Standards” with “R11 (or R10 V4) or above”,
Section 19 - Sanitary		
19.01	Generally	<p>Add below paragraphs after the 1st paragraph:</p> <p>“The water usage for all products shall meet the Grade 1 water efficiency rating (i.e. nominal flow rate of less than or equal to 9 litres per minute) for Showers for Bathing of the Voluntary Water Efficiency Labelling Scheme (WELS) of Water Supplies Department unless product with other water efficiency ratings is required to meet particular functional purpose as specified in the Particular Specification.</p> <p>All products shall not contain heavy metals like lead, cadmium, mercury or hexavalent chromium and organically bound halogens.”</p>
19.02	Scope of Work	In the 2nd paragraph, replace “General Specification for Plumbing and Drainage Installation” with “General Specification for Plumbing and General Specification for Drainage Installation”
19.09.02	Stainless steel sinks	Replace “Stainless steel grade 304 or grade 316 as specified in Clause 17.09, minimum thickness 0.8 to 0.9 mm for Grade 304 and 1.5 to 1.6 mm for grade 316, with satin finish” with “All sinks, shall be fabricated of not less than 1.6 mm polished stainless steel except hand basins of at least 1.2mm, with stainless steel grade 316, and of the size and design as specified.”
19.11.02	Squat type W.C	Add “Singapore Standard” before “ SS 379 ”.
19.11.03	Flushing cistern	<p>In the 1st paragraph, replace “7.5L flushing cistern to BS 7357, 9L and dual flushing type cisterns to BS 1125,” with “The toilet should be dual-flush type, and the maximum flushing-water volume should be less than 3 liters and 6 liters per reduce flush and per full flush respectively”</p> <p>In the 2nd paragraph, replace “DZR brass” with “Dezincification resistant brass (DZR) brass” and “Dry battery operation shall be 6V Lithium 2 CR5. A/C operate shall be 220-230/50Hz step down to 6V” with “The sensor shall either be operated by 6V Lithium battery or 220V AC power step down to 6V”.</p>
19.12	Urinals	In the 2nd paragraph, replace “DZR brass” with “Dezincification resistant brass (DZR) brass” and “Dry battery operation shall be 6V Lithium 2 CR5. A/C operate shall be 220-230/50Hz step down to 6V” with “The sensor shall either be operated by 6V Lithium battery or 220V AC power step down to 6V”.
19.13	Glazed Ceramic Slab Urinal	In the 1st paragraph, replace “The length of urinal slab shall be max. 4200 mm” with “The length of urinal slab shall be as approved by Supervising Officer”

Clause No.	Sub-heading of Clause	Major Changes
19.14	Stainless Steel Slab Urinal	Replace “the length of slab not exceed 4200 mm” with “the length of slab as approved by Supervising Officer”
19.17	Silicone Sealant	Add paragraph “All sealants 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.” after the 2nd paragraph.
19.22	Fixing wash basins	In the 1st paragraph, replace “Wash basins shall be supported on one of the following as specified:” with “Wash basins shall be supported on approved proprietary brackets to suit the basins or counter top as on drawings or manufacturer’s details.” Delete sub-clause (a), (b), (c), (d) and (e).
19.23	Fixing W.C. pans	In sub-clause (a)(i), delete “white lead putty or”
Section 20 - Glazing		
20.00.01	Ordinances, Regulations, Codes and standards	Add a new clause “Comply with the documents contained in this Specification as defined in Index 4 , regarding Ordinances, Regulations, Code of Practices, Standards and PNAP 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.” after Clause 20.00 .
20.01	Glass Generally	Replace “ BS 952-1, BS952-2: or ASTM C1036 – 11 ” with “ BS 952-1, BS 952-2 or ASTM C1036-16 ”.
20.01.04	Flatness	In the 1st paragraph and sub-clause (v), replace “ ASTM C1048 – 04 ” with “ ASTM C1048-12e1 ”.
20.01.09	Flatness	In sub-clause (i) & (ii), replace “live load pressures” with “imposed load pressures”.
20.01.11	Flatness	In sub-clause (i), replace “ ASTM C509 - 06(2011) ” with “ ASTM C509 - 15 ”. In sub-clause (ii), replace “ ASTM C864 - 05(2011) ” with “ ASTM C864- 15 ”.
20.02	Float glass	Replace “ ASTM C1036 – 11 ” with “ ASTM C1036-16 or BS EN 572-2 ”.
20.06	Mirror glass	Replace “ ASTM C1036 – 11 ” with “ ASTM C1036-16 ”.
20.07	Heat strengthened glass	In sub-clause (i), replace “ ASTM C1048 – 04 ” with “ ASTM C1048-12e1 ”.

Clause No.	Sub-heading of Clause	Major Changes
20.08	Fully tempered glass	In sub-clause (i), replace “ASTM C1048 – 04” with “ASTM C1048-12e1”. In sub-clause (iii), add “APP-53 and APP-110 where applicable to the satisfaction of the SO,” after “It must also be noted that heat soak testing in accordance with APP-37,” and replace “BS EN 14179-1” with “BS EN 14179”.
20.09	Tinted glass	Replace “ASTM C1048 – 04” with “ASTM C1048-12e1”.
20.10	Coated glass	In sub-clause (ii), replace “ASTM C1376– 10” with “ASTM C1376-10 or BS EN 1096-1 to BS EN 1096-4”.
20.11	Laminated safety and security glass	In sub-clause (ii), replace “ASTM C1172– 09” with “ASTM C1172-14 or BS 6262”.
20.17	Generally	In the 1st paragraph, replace “BS 8000-7” with “BS 8000-7 and BS 8000-0”.
20.26	Structural sealant glazing	Replace “Structural sealant glazing shall be applied according to BS 6262-6, BS EN 13022-1:2006+A1:2010 and BS EN 13022-2:2006+A1:2010” with “Structural sealant glazing shall comply with APP-37 and APP-53. It shall be applied according to BS 6262-6, BS EN 13022-1 and BS EN 13022-2”.
Section 21 - Painting		
21.90	Environmental Green Requirements	Replace Sub-heading of Clause “Volatile Organic Compound content” with “Environmental Green Requirements”. Replace the 1st paragraph “The Volatile Organic Compound (VOC) content, in grams per litre, of all regulated paint stated in the Air Pollution Control Ordinance (Cap 311) shall not exceed the prescribed limit specified in the Air Pollution Control Ordinance (Cap 311).” with sub-clause (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.” Replace the 2nd paragraph “The testing of the VOC content of paint shall be determined in accordance to the Air Pollution Control Ordinance (Cap 311).” with sub-clause (b) “Green requirements of Varnish and Wax Polish.”
		Add sub-clause (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).”, sub-clause (ii) “The product shall contain no more than 0.01% by wet weight of formaldehyde.” and sub-clause (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.”

Clause No.	Sub-heading of Clause	Major Changes
Section 22 - Internal Fittings and Fixtures		
22.01	Construction of the system	Add “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.”
22.29	Screen fabric	Add “Specification for resistance to ignition” after BS 7176 2007+A1
22.71	Compartments	Delete the 1st paragraph, ‘Locker compartment shall have minimum internal dimensions of 260 mm (height) x 250 mm (width) x 450 mm (depth).’
Section 23 - Plumbing and Drainage		
23.01	GS and T&C Procedure for plumbing & drainage	Replace ‘General Specification for Plumbing and Drainage Installation in Government Buildings of the Hong Kong Special Administrative Region 2012 Edition.’ with “General Specification for Plumbing Installation in Government Buildings of the HKSAR 2017 Edition; General Specification for Drainage Installation in Government Buildings of the HKSAR 2017 Edition; Testing and Commissioning Procedures for Plumbing Installation in Government Buildings of the HKSAR 2017 Edition; and Testing and Commissioning Procedures for Drainage Installation in Government Buildings of the HKSAR 2017 Edition.”
Section 24 - External Works		
24.01	Roads, car-parks and paved areas generally	<p>In the 1st paragraph, replace “such work will be specified in accordance with Section 11 on Miscellaneous Roadworks” with “such work will be specified in accordance with Section 10 on Concrete Carriageways and Section 11 on Miscellaneous Roadworks”</p> <p>In the 2nd paragraph, replace “paved areas shall comply with the requirement in Highways Department Standard Drawings” with “paved areas shall comply with the requirements in Section 1 of the Highways Department Standard Drawings”</p>
		Add a new paragraph “For all external works that are used as roads, carriageway, car parks or paved areas for the purpose of future handover to Highways Department for maintenance, such works shall be constructed in compliance with Highways standards as promulgated by Highways Department.” after the 3rd paragraph.
24.02	Insitu concrete paving	In the 1st paragraph, replace “such works need to comply with Part 6 of Section 11 on Miscellaneous Roadworks” with “such works need to comply with Section 10 on Concrete Carriageways or Part 6 of Section 11 on Miscellaneous Roadworks”

Clause No.	Sub-heading of Clause	Major Changes
Section 25 - Landscape Work		
25.09	Forming and handling soil heaps	In sub-clause (e), replace “ BS 4428 ” with “ BS 4428 with reference to BS 3882 ”.
25.69	Old and Valuable Tree	In sub-clause (b), replace “posted at website: http://www.lcsd.gov.hk/LEISURE/LP/gc/tree ” with “posted at the website maintained by Leisure and Cultural Services Department”.
25.69.2	Site supervisory staff and preservation and protection of existing trees	In sub-clause (b), replace “supervise tree works related to horticultural operations and preservation of trees within the Site” with “supervise tree works related to arboricultural operations and preservation of trees within the Site”, “The assigned person shall have attended relevant training on the subject organized by training institutes (such as Construction Industry Training Authority), or similar courses as considered appropriate by the SO.” with “The assigned person shall have attended relevant training on arboriculture organized by local / overseas training institutes (e.g. Construction Industry Council Training Academy, Vocational Training Council) with cumulative training of at least 30 hours in the past 3 years, and have at least two years practical experience in arboriculture.” and “within 45 days” with “within 30 days” and add “and supporting documents on the required experience” after “the relevant course”.
25.69.14	Other references on arboricultural / tree work	Delete “ BS 4043 Recommendations for Transplanting Root-Balled Trees”.
25.74	Preparation of planting pit at receptor site	<p>Replace Sub-heading of Clause “Direct planting in receptor site” with “Preparation of planting pit at receptor site”.</p> <p>Replace sub-clause (a) “Tree transplanted directly to the final receptor site is to be planted and secured, if required, in accordance with the Clauses 25.29 and 25.30, unless otherwise proposed by the Contractor and approved by the SO.” with “During planting pit preparation, the existing topsoil ploughed from digging shall be stripped and put aside for reuse as much as possible and to avoid a distinct interface between the pit and the surrounding soil.”</p> <p>Replace sub-clause (b), “Synthetic or treated hessian around the root ball must be removed upon planting in the receptor site. Natural hessian should also be removed, if practicable, or to fold back, to ensure roots can grow out of the root ball. All pins and twines shall also be removed to avoid girdling the tree.” with “The planting pit shall be:”</p>
		Add sub-clause (i) “with drainage to allow effective percolation of water;”, sub-clause (ii) “prepared to prevent settling;”, sub-clause (iii) “dug to the depth not exceeding the depth of the root ball and the sides of the pit shall be scarified;” and sub-clause (iv) “in terms of the width, at a minimum of 1.5 times the diameter of the root ball or as approved by the SO”.
25.74.1	Direct planting in receptor site	Replace Clause No. “ 25.74 ” with “ 25.74.1 ”.
25.74.2	Replanting from holding nursery to receptor site	Replace Clause No. “ 25.74.1 ” with “ 25.74.2 ”.

Clause No.	Sub-heading of Clause	Major Changes
25.74.3	Immediate maintenance	Replace Clause No. “ 25.74.2 ” with “ 25.74.3 ”.
25.74.4	Watering upon transplanting	Replace Clause No. “ 25.74.3 ” with “ 25.74.4 ”.
25.74.5	Mulch	Replace Clause No. “ 25.74.4 ” with “ 25.74.5 ”.
25.74.6	Weeding to rootball	Replace Clause No. “ 25.74.5 ” with “ 25.74.6 ”.
25.74.7	Crown cleaning	Replace Clause No. “ 25.74.6 ” with “ 25.74.7 ”.
25.79	Planting and maintenance of transplanted semi-mature trees	Replace “Clauses 25.74 to 25.74.6 shall apply” with “Clauses 25.74 to 25.74.7 shall apply”.
Section 26 – Geotechnical Works on Soil and Rock Slopes		
26.23	Records of Sprayed Concrete	Add “The records could be either a hard copy or soft copy as agreed by the SO. The hard copy report shall use recycled papers. The soft copy shall be in read-only format and the hard copy shall be double side printed as agreed by the SO.”
26.34	Material	In sub-clause (a), replace “high yield deformed bars and comply with” with “Grade 500B ribbed steel reinforcing bars to”.
26.55	Crushing strength of grout	In sub-clause (b), replace “Clause 26.54” with “Clause 26.55(a)”. In sub-clause (c), add “in” after “as stated”.
26.59	Relief drains	In sub-clause (a), replace “Relief drains shall be of Netlon 20-100FC or 30-200FC type as specified in the Contract or alternative products having equivalent functions or performance approved by the SO.” with “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.”.

Clause No.	Sub-heading of Clause	Major Changes
26.63	Erosion control mats	<p>Replace the 1st paragraph of sub-clause (a) with:</p> <p>“(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.</p> <p>(ii) Biodegradable mats for erosion control shall be woven coir mesh mats or woven jute mats.</p> <p>(iii) The mats shall have the material properties as stated in the Contract.</p> <p>(iv) The mats must be produced by proprietary manufacturers and specifically designed for the erosion control of sloping ground.”</p> <p>At the beginning of sub-clause (a)(i), add sub-clause (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.”.</p> <p>At the end of sub-clause (b), add</p> <p>“(v) Details of equipment, and</p> <p>(vi) A certificate from the manufacturer on the compliance of the materials, as and where appropriate.”</p>
26.65	Painting to sprayed concrete	<p>In sub-clause (c). replace “Do not store” with “Store”.</p> <p>After sub-clause (c), add</p> <p>“(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.”</p>
Index 2 – Subjects and Clause Numbers		
-	-	For Clause No. 1.09, replace “Proprietary brand name materials or products” with “Proprietary brand name products or materials”
	Re-numbering of Subjects	<p>Replace “Crown cleaning 25.74.6” with “Crown cleaning 25.74.7”.</p> <p>Replace “Direct planting in receptor site 25.74” with “Direct planting in receptor site 25.74.1”.</p> <p>Replace “Dry season watering 25.74.3 (b)” with “Dry season watering 25.74.4(b)”</p> <p>Replace “Immediate maintenance 25.74.2” with “Immediate maintenance 25.74.3”.</p> <p>Replace “Mulch 25.74.4” with “Crown cleaning 25.74.5”.</p> <p>Replace “Replanting from holding nursery to receptor site 25.74.1” with “Replanting from holding nursery to receptor site 25.74.2”.</p> <p>Replace “Watering upon transplanting 25.74.3(a)” with “Watering upon transplanting 25.74.4(a)”.</p> <p>Replace “Weeding to rootball 25.74.5” with “Weeding to rootball 25.74.6”.</p>

Clause No.	Sub-heading of Clause	Major Changes
Index 3 – List of Standards		
	BS 4482	Replace “BS 4482:1985” with “BS 4482:2005” Replace “BS 4483:1985” with “BS 4483:2005”
	CS2	Replace “26.34” with “6.14, 6.15, 6.17, 6.25.4, 26.29, 26.34”
	CS3	Replace “Table 6.16” with “Table 6.13”
	Code of Practice for structural use of concrete	Replace “ Code of Practice for Structural Use of Concrete 2004 (Second Edition) ” with “ Code of Practice for Structural Use of Concrete 2013 ”
Add a new Index 4 – List of Ordinances, Regulations, Codes and Standards for Section 16 and 20		