

Materials and Workmanship
Specification
For Architectural Works



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10 QUALITY

10.1 GENERAL

10.1.1 INTERPRETATION

Definitions

For the purposes of this worksection the following definitions apply:

- Quality package: A designated part of the works identified under a heading in the Co-ordinated Installation Programme. An individual quality system is required for each quality package.
- Contractor: The supplier of a product to the Authority within the defined quality package. Includes the contractor's subcontractors and suppliers.
- Product: That which is supplied by the contractor, which may be either
 - . tangible (e.g. a built item);
 - . intangible (including services such as design and delivery of tangible product); or
 - . both.
- Servicing: "After sales" service, repairs, maintenance.
- Working days: do not include Saturdays, Sundays or recognized public holidays in the Republic of Singapore.

10.1.2 QUALITY SYSTEM REQUIREMENTS

Quality system schedule

Quality package	Activities included	Standard	Options
All	All	ISO 9001	Nil
>	>	>	>
>	>	>	>

Document control

Changes to documents: Review and make changes to shop drawings to take account of the Engineer's comments using the same functions or organisations that created the original, except as described in the **Document control schedule**.

Document control schedule

Quality package	Documents to be reviewed and approved	Other designated organisation
>	>	>
>	>	>
>	>	>

Purchasing

External audits: Carry out pre-tender surveys of subcontractors and suppliers and audit subcontractors and suppliers as necessary to confirm their capability to meet the Authority's requirements. All surveys and audits are to be performed by a trained auditor accepted by the Engineer. Include audit and surveillance proposals in the package quality plan along with the results of pre-tender surveys.

Verification: The Engineer may verify at source, or upon receipt, that the purchased product conforms to requirements.

All costs pertaining to all relevant verification are to be borne by the Contractor.

Installation

Carry out installation checks identified in method statements, and at all identified hold and witness points, to confirm the product meets the Authority's requirements. All checks are to be performed by a staff member identified in the method statement and accepted by the Engineer.

Verification: The Engineer may carry out independent checks to verify that the purchased product conforms to requirements.

Product identification and traceability schedule

10 QUALITY

Quality Package	Product	Traceability required	Product identification required	Method
>	>	>	>	>
>	>	>	>	>
>	>	>	>	>

Control of nonconforming product

Concession: Before the provision or repair of a nonconforming product, report the proposal to the Engineer for Acceptance. Do not provide or repair nonconforming product without the Engineer's acceptance.

Quality records

Retention: Retain quality records for 7 years from the date of the final certificate unless identified otherwise in the schedule below.

Evaluation: Make quality records available to the Engineer for evaluation, within 2 days of checks carried out on site: 5 days of checks carried out off site and 7 days for checks carried out overseas.

Period of evaluation: To be agreed at each request, within a minimum of 5 working days and a maximum of 15 working days.

Quality records retention schedule

Quality package	Retention period	Location during retention period	Form for retention	Content of documents
>	>	>	>	>
>	>	>	>	>
>	>	>	>	>

Servicing schedule

Ensure all servicing requirements are included in the operation and maintenance manuals delivered to the Engineer.

Complete the schedule below for items serviced prior to handover. Include all reports prepared by the service engineer in the operation and maintenance manuals delivered to the Engineer.

Quality package	Product	Servicing (maintenance) required
>	>	>
>	>	>
>	>	>

10.1.3 SUPPLEMENTARY REQUIREMENTS

Quality plan approval

Submit to the Supervising officer, for approval, a quality plan for each quality package, at least 15 working days before work on that package commences. Keep on site a copy of the approved quality plan.

No. of copies to be submitted: 3.

Quality plan

General: Comply with the recommendations of SPRING Singapore. Include inspection and test plans.

Quality manual: Comply with the recommendations of SPRING Singapore.

Audit plan: Comply with the recommendations of SPRING Singapore.

20 GENERAL REQUIREMENTS

20.1 CROSS REFERENCES

General

Conform to the Land Transport Authority General and Particular Specifications issued for the works.

20.1.1 CIVIL DEFENCE (CD) REQUIREMENTS

General

Where stations are identified as having Civil Defence (CD) requirements, refer to the CD Design Criteria for requirements and information relating to the upgrading of materials, material thicknesses, composition and fixing methods for CD stations.

20.2 GENERAL

20.2.1 GENERAL

Precedence

Requirements of individual technical worksections of the specification override conflicting requirements in this worksection.

20.2.2 USE

It is intended that this specification:-

forms the basis of all Architectural Materials and Workmanship specifications.

is completed by users to suit their particular project in the following manner:-

Delete all sections and clauses not required by the project.

Complete all clauses where the symbol > is found by providing information to suit the project.

Add any requirements not covered by the specification retaining the written style of the specification.

All added requirements are subject to acceptance by The Land Transport Authority.

All added requirements may be retained by the Land Transport Authority for use in future editions of this base specification.

Completed project specifications are subject to acceptance by The Land Transport Authority.

20.2.3 REFERENCED DOCUMENTS

Current editions

Use referenced documents which are editions, with amendments, current 3 months before the date of tender, except where other editions or amendments are required by statutory authorities.

Site copies: ensure a copy of all standards referred to in the specification is available, in English, for use by the Contractor and Authority's staff throughout the duration of the works.

For the purposes of this specification, where standards provide information in imperial units it shall be converted to metric in accordance with BS 350: Parts 1&2.

Where the standards referred to in this specification make recommendations or suggestions, these shall be taken as mandatory requirements.

In the event of conflict or contradiction between referenced standards, or within this specification, the most onerous requirement shall be adopted.

Contractual relationships

Read all architectural drawings in conjunction with the structural and services design including combined services drawings (CSD) and structural electrical and mechanical (SEM) drawings and other installation drawings issued on the project.

Verify all dimensions on site prior to:

- The start of shop drawings.
- The ordering of material.
- The start of installation works.

Resolve any discrepancies on site prior to the start of the works.

Language

The English language shall be used throughout this specification

General standards

Plumbing and drainage: To AS/NZS 3500.2.2.

Units of measurement: To AS ISO 1000.

20.2.4 INTERPRETATION

General

The following definitions apply:

- Accepted: "Accepted", "reviewed", "directed", "rejected", "endorsed" and similar expressions mean "accepted (reviewed, directed, rejected, endorsed) in writing by the Engineer.
- Engineer: The person appointed by the Land Transport Authority to act as the Engineer for the purposes of the main contract. All references to the Engineer in this specification shall be taken to include the Engineer's Representative.
- Engineer's Representative: Any person appointed by the Engineer to assist him in his duties or to perform any other duties assigned to him by the Engineer.
- Exterior: "Exterior" and "External" refer to spaces outside the perimeter wall of the building.
- Give notice: "Give notice", "submit", "advise", "inform" and similar expressions mean "give notice (submit, advise, inform) in writing to the Engineer.
- Interior: "Interior" and "Internal" refer to building spaces within the perimeter wall of the building.
- Non-Combustible; To BS 476, Part 4.
- Obtain: "Obtain", "seek" and similar expressions mean "obtain (seek) in writing from the Engineer.
- Proprietary: "Proprietary" mean identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: "Provide" and similar expressions mean "supply and install".
- Samples: Includes samples, prototypes and sample panels.
- Substantial completion: "Substantial Completion" and "Practical Completion" are synonymous terms.
- Supply: "Supply", "furnish" and similar expressions mean "supply only".

Technical

Metallic coated steel: Includes zinc-coated steel, zinc/iron alloy-coated steel, and aluminium/zinc-coated steel.

Pipe: Includes pipe and tube.

Tests

Except where otherwise defined in referenced documents, the following definitions apply:

- Pre-completion tests: Tests carried out before completion tests.
- Type tests: Tests carried out on an item identical with a production item, before delivery to the site.
- Production tests: Tests carried out on the purchased equipment, before delivery to the site.
- Site tests: Tests carried out on site.
- Completion tests: Acceptance tests and final tests.
- Acceptance tests: Tests carried out on completed installations or systems and, except for final tests, before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements.
- Final tests: Acceptance tests carried out before completion of the maintenance period.

Maintenance period

Co-extensive with the defects liability period.

Abbreviations

AAMA: American Architectural Materials Association.

ABS: Acrylonitrile-butadiene-styrene.

AS: Australian Standard.

AS/NZS: Australian/New Zealand Standard.

ASTM: American Society for the Testing of Materials.

BCA: Building and Construction Authority: Singapore.
BMS: Building management system.
BS: British Standard.
CD: Civil Defence. Singapore.
CFC: Chloroflourocarbon.
CSD: Combined services drawings.
EPDM: Ethylene-propylene dienemonomer.
FARIMA: The Fibreglass and Rockwool Insulation Manufacturer's Association of Australia.
GRP: Glass-fibre reinforced polyester.
ISO: International Standards Organisation.
LTA: Land Transport Authority: Singapore.
M&E: Mechanical and Electrical.
MIG: Metal Inert Gas.
NATA: National Association of Testing Authorities, Australia.
NEBB: National Environmental Balancing Bureau, Australia.
PE: Professional Engineer registered in Singapore.
PSB: Singapore Productivity and Standards Board.
PVF₂: Polyvinylidene fluoride.
PTFE: Polytetrafluoroethylene.
PTFE: Polyvinyl Butral (plastic interlayer in laminated glass).
QP: Qualified person (architect) registered in Singapore.
SEM: Structural Electrical and Mechanical.
SIA: Singapore Institute of Architects.
SS: Singapore Standard.
SSL: Scientific Services Laboratory, Australia.
SWC: System Wide Contractor.
STC: Sound transmission co-efficient.
TT-S: American Federal Specification.
UDL: Uniformly distributed load.
UPVC: Unplasticised polyvinyl chloride.
UV: Ultra violet light.
U-value: Heat loss, watts/square metre/degree Kelvin W/m^2K .

20.2.5 REGULATORY AUTHORITY'S APPROVALS

General

Arrange all inspections and approvals required by regulatory authorities in sufficient time to ensure the regular progress of the works and eliminate unnecessary delays.

Provide documentary evidence of all required inspections and approvals prior to covering work.

20.2.6 CONTRACT DOCUMENTS

General

Architectural details shown on the drawings show design intent only, except where noted otherwise.

Follow figured dimensions where provided or calculable. Before commencing work, obtain site measurements and all other necessary information. Cross Refer: Contractual Relationships, Item 2.3 above.

Levels: Spot levels take precedence over contour lines and ground profile lines.

20.2.7 DESIGN

Equipotential bonding requirements (EPB)

Comply with the requirements of Section 13.9 of the Authority's Design Criteria Volume 2 of 2, and Singapore Standard CP5.

Touch voltage protection

Comply with the requirements of Section 13.3 of the Authority's Design Criteria Volume 2 of 2 where metals are proposed within the station protection zone.

Constructability

The works shall be designed to maximise prefabrication, utilising factory finished elements to be erected directly with minimal site works.

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20.3 QUALITY

20.3.1 INSPECTION

Notice

Witness points: Written notice of inspection is to be given. Advise if and when parts are to be concealed.

Hold points: Written notice of inspection is to be given. Do not conceal those parts of the works to be inspected without approval.

Minimum notice for inspections to be made: 1 working day for on-site inspectors, otherwise 2 working days.

Concealed services: Give notice so that inspection may be made of all items, including works by System Wide Contractors to be concealed.

Insufficient notice: insufficient or unreasonably short notice shall not constitute grounds for a claim of delay.

Notice: provide the following information in all notices for inspection.

- The location of the inspection.
- That date and time on which the inspection is required.
- Whether or not the part is to be concealed.
- The extent of disruption to subsequent activities should the item to be inspected be rejected.
- The date on which subsequent work is programmed to start.

20.3.2 TESTS

General

The engineer reserves the right to request that materials proposed for the works are tested as required by this specification. The costs for all required tests shall be borne by the Contractor.

Programme

Submit a testing program which is consistent with the construction program. Include particulars of test stages and procedures.

Notice

General: Give notice so that designated tests may be witnessed.

Hold points: Do not carry out designated tests without approval.

Minimum notice for tests to be witnessed:

- 5 working days for site tests; and
- 10 working days for local (including Peninsular Malaysia) pre-delivery tests.
- 15 working days for tests carried out overseas (excluding Peninsular Malaysia).

Testing authorities

General: Except for site tests, have tests carried out by authorities accredited by SINGLAS to test in the relevant field, or an organisation outside Singapore recognised by SINGLAS through a mutual recognition agreement. Cooperate as required with testing authorities.

Site tests: Use instruments calibrated by authorities accredited by SINGLAS.

Reports

General: Submit copies of test reports, including certificates for type tests, showing:-

- the observations and results of tests.

- compliance or non-compliance with requirements.
- that materials are capable of performing as specified for the lifetime.
- that materials are capable of performing as specified in the ambient climatic conditions of Singapore and in the location in which they are used.

Materials will not be accepted as being in compliance with this specification until the test certification is accepted by the Engineer.

No. of copies of test reports and certificates: 3.

Endorsement

If site tests are to be carried out on parts of the works, do not conceal those parts and do not commence further work on those parts until the tests have been satisfactorily completed and compliance verified.

Test records

For designated tests, including pre-delivery tests, record results and submit reports or certificates in a form suitable for inclusion in operation and maintenance manuals.

20.3.3 PRE-COMPLETION TESTS

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20.3.4 SAMPLES

General

Provide a sample room for the storage of all samples on site. Ensure adequate lighting, shelving, racks and other furniture as required within the room.

Timing

Delays: Coordinate submissions of related samples.

Quantity

General: Unless noted otherwise in individual specification sections, submit 3 samples of each designated item and supporting documentation. Include ancillary items such as fasteners, flashings and seals.

Identification

Cross refer: Item 3.6 Submissions.

Approval

General: Do not commence work affected by samples until the samples have been accepted. Submit further samples as necessary.

Retention

Keep accepted samples in good condition on site, until practical completion.

Incorporation

If it is intended to incorporate samples into the works, submit proposals.

Incorporate in the works samples which have been accepted for incorporation. Do not incorporate other samples.

Criteria

Match accepted samples throughout the works.

20.3.5 PROTOTYPES

Generally

Co-ordinate the submission and acceptance of all samples and shop drawings relevant to the construction of a prototype.

Agree the location of all prototypes with the Engineer.

Do not commence work illustrated by a prototype prior to the Engineer's acceptance of the prototype.

Protect all prototypes from damage for the duration of the works.

Accepted prototypes may be incorporated into the works with the Engineer's agreement.

Remove all prototypes which are not accepted by the engineer.

Design Prototype:

Design prototypes shall be specifically referred to in the documentation.

Design prototypes are intended to demonstrate to the Engineer that the works, or part of the works as designed will be capable of satisfying the requirements of the contract.

All general conditions referred to above apply equally to design prototypes.

Design prototypes may be used for testing purposes.

Design prototypes may be constructed on or off the site as agreed with the Engineer.

Make allowance for the need to revise design prototypes prior to their acceptance by the Engineer.

Confirmation Prototype:

A confirmation prototype is an installation identical, in all respects, to the remainder of the works. It is intended as confirmation of construction methods and standards of workmanship.

Unless specifically referred to, all references to confirmation prototypes shall be to prototypes constructed on site

20.3.6 SUBMISSIONS

General

Submit a complete list of products, manufacturers and fabricators for each specification section prior to submitting shop drawings and/or samples.

Timing

General: Submit documents in a timely manner, to suit the construction program. Make allowance for the need to revise all documentation prior to its acceptance by the Engineer. Co-ordinate submissions of related items.

Quantity

As determined by the Particular Specification.

Identification

Label each submission to identify the project, contractor, subcontractor or supplier, manufacturer, applicable product, model number and options, as appropriate and include pertinent contract document references. Include service connection requirements and product certification. Identify non-compliances with project requirements, and characteristics which may be detrimental to successful performance of the completed work.

Endorsement

Witness points: Give notice before commencing work affected by contractor's submissions, unless the submissions have been accepted as satisfactory.

Hold points: Do not commence work affected by contractor's submissions until the submissions have been accepted as satisfactory.

Errors: If a document contains errors, submit a new or amended document as appropriate, indicating changes since the previous submission.

Design

General: If part or all of an installation is to be designed by the contractor, submit documents showing the layout and details of the installation.

Variation documents: If it is proposed to change the installation from that shown on the contract documents, or if changes are required by statutory authorities, submit variation documents showing the proposed changes.

Errors

If a submission contains errors, make a new or amended submission as appropriate, indicating changes made since the previous submission.

Shop drawings

General:

Submission: means the initial submission, and all subsequent re-submissions of shop drawings.

Submit dimensioned drawings showing details of fabrication and installation of services and equipment, including relationship to building structure and other interfaces services, cable type and size, and marking details.

Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and submit dimensioned set-out drawings. Verify all dimensions on site prior to the preparation of shop drawings.

Requirement: shop drawings shall include drawings, diagrams, illustrations, schedules, performance charts and other data prepared by manufacturers, suppliers and distributors necessary to the illustration of the work.

Site copies: Amend the drawings to correct errors or omissions and to show changes made after submission. Resubmit amended copies.

Check all shop drawings prior to submission: confirm that they co-ordinate with all other shop drawings produced on the project and that they comply with the requirements of the contract documentation.

Obtain endorsement by a QP (qualified person) prior to submission.

Drawing Format

All shop drawings shall be prepared to the following format:-

- Titles: shall follow the Land Transport Authority's standard format.
- Drafting: All drawings shall fully cross referenced and legible when reduced to A3 size.
- Amendments: All amendments shall be identified in the drawing title box by a revision letter, date and description of the amendment. 'Cloud' all amendments on the drawings, identifying them with the appropriate revision letter. Remove all 'clouding' from amendments identified on previous editions of the drawings, and accepted by the Engineer.

Interfacing details

Co-ordinate all interfacing details and submit these as part of the shop drawing package for each interfacing material.

Where interfacing details are not shown, or considered not to be shown in sufficient detail, the entire package of shop drawings shall be rejected.

Records:

Prepare and maintain a record of all shop drawings to show

- Drawing number, title and amendment.
- Date required for approval.
- Date of issue and all subsequent re-issues.
- Recipients.
- Date of approval.

Engineering endorsement

All structural requirements shall be endorsed by a Professional Engineer registered in Singapore (PE) engaged by the Contractor concurrently with the submission of the shop drawings to which they refer.

All structural drawings prepared in support of the PE's calculations shall be classed as shop drawings and prepared in compliance with the requirements of this specification.

All calculations prepared by the PE shall include a complete structural analysis to show the resultant effects of the anticipated forces on all applicable structural components including, but not limited to, anchors, rods, welds, and fasteners.

The anticipated forces include, but are not limited to, thermal movement, vibration, wind and air pressure, including train induced air pressures, crowd loading and, where appropriate, pressures resulting from human impact.

Authorities

Correspondence: Submit copies of correspondence and notes of meetings with authorities.

Authorities' approvals: Submit documents showing approval of the authorities whose requirements apply to the work.

Subcontractors and installers

Submit name and contact details of proposed specialist subcontractor(s) and installer(s).

Submit details of all specialist subcontractor(s) past experience in the work they are being employed to do, including the address of past projects and details of both past employers and architects.

Where required, arrange access to allow the Engineer to inspect the specialist subcontractor(s) past work.

Submit subcontractor's and/or installer's confirmation that the substrate is ready to receive the installation.

Materials and components

Product data: For proprietary equipment, submit the manufacturer's product data including:

- technical specifications and drawings;
- type test reports;
- performance and rating tables;
- recommendations for installation and maintenance;
- country of origin;
- health and safety data sheets.

Proposed products schedules: Within 3 weeks of site possession submit a schedule of proprietary products proposed for use.

Product certification: If products must comply with product certification schemes, submit evidence of compliance.

Method Statement

Submit method statements for all fabrication, installation and construction work concurrent with the submission of shop drawings.

Method statements shall include, but not be limited to, details of the following:-

- The person in charge of the work on site including name, position in the company and limits of responsibility.
- All health and safety measures necessary to protect the workforce.
- All witness and hold points necessary to ensure the works will meet the specified requirements.
- All tests necessary to ensure the works will meet the specified requirements.
- All temporary structures.
- The storage, movement and installation of all materials.
- All interfaces.
- Protection of the completed or partially completed work.
- The disposal of all waste material.
- All records that will be kept of the work.

Obtain endorsement by a qualified person prior to submission.

20.3.7 PRE INSTALLATION CONFERENCE

Convene a pre-installation conference for all work to be installed by specialist sub-contractors, manufacturers or suppliers.

Invite all parties affected by the installation, including, but not limited to, the Engineer, the sub-contractor's site representative taking responsibility for the installation, and affected suppliers technical representatives.

Hold the conference a minimum of one week prior to starting work on site.

Record the conference and issue minutes noting all agreements, disagreements and decisions taken, to all affected parties within 2 working days of the conference.

20.4 MATERIALS AND COMPONENTS

20.4.1 GENERAL

Sources policy

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Alternatives

If alternatives are proposed, submit proposed alternatives and include samples, available technical information, reasons for proposed substitutions and cost. If necessary, provide an English translation. State if provision of proposed alternatives will necessitate alteration to other parts of the works: advise consequent costs and effects on the programme.

Manufacturers' or suppliers' recommendations

General: Select, if no selection is given, and transport, deliver, store, handle, protect, finish, adjust, prepare for use, and provide manufactured items in accordance with the current written recommendations and instructions of the manufacturer or supplier.

Instructions: Submit the recommendations and instructions, and advise of conflicts with other requirements.

Project modifications: Advise of activities that supplement, or are contrary to, manufacturer's or suppliers' written recommendations and instructions.

Product certification: If products must comply with product certification schemes, provide them in accordance with the certification requirements.

Sealed containers

If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

Consistency

For the whole quantity of each material or product use the same manufacturer or source and provide consistent type, size, quality and appearance.

Ensure that all adjacent items, or items capable of being seen together, are obtained from the same batch.

Separation

Identify all locations where contact between adjacent materials will lead to a reduction in the anticipated life span of either.

Prevent direct contact between incompatible materials by either

- Inserting an acceptable separation layer.
- Coating the contact face of the materials.

Corrosion

The discovery of corrosion shall be considered a 'hold point' on the affected item of work.

Inform the Engineer immediately any corrosion is identified on metal work supplied to, or installed in, the works.

Do not treat any corroded item on installed work without the Engineer's prior approval of a method statement for the treatment.

Where required by the Engineer, replace all corroded items.

20.4.2 SERVICES COORDINATION

General

Documentation: Prepare detailed drawings of the proposed positioning of plant and equipment:

- Ensure coordination with other building and service elements.
- Show adjusted positions on the shop and record drawings.
- Provide details of all loadings imposed on the structure.

20.4.3 BUILDING PENETRATIONS

General

All details of building penetrations must be submitted to the Engineer and the appropriate System Wide Contractor for acceptance prior to work starting on site.

Piping sleeves

General: Provide metal sleeves formed from pipe sections for piping penetrations through building elements.

Sleeve diameter (for non fire-rated building elements): Sufficient to provide an annular space around the pipe or pipe insulation of at least 12 mm.

Minimum sleeve thickness:

- Metal: 1 mm.

Sleeve terminations:

- If cover plates are fitted: Flush with the finished building surface.
- In floors draining to floor wastes: 50 mm above finished floor.
- In fire-rated and acoustic-rated building elements: 50 mm beyond finished building surface.
- Elsewhere: 5 mm beyond finished building surface.

Finish: Prime paint ferrous surfaces: Cross refer: 'Painting'.

Cable sleeves

Provide sleeves formed from accepted non conductive materials for penetrations through ground floor slabs, beams and external walls by cables not enclosed in conduit. In addition, for MIMS cables, provide sleeves for penetrations through masonry.

Fire rated building elements

Cross Refer: 'Fire Stopping'.

Non-fire rated building elements

Seal penetrations around conduits and sleeves. Seal around cables within sleeves. If the building element is acoustic rated, maintain the rating.

Limitations

General: Do not penetrate or fix to the following without approval:

- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings.

Membranes: If agreement is given to penetrate membranes, provide a waterproof seal between the membrane and the penetrating component.

20.4.4 CONCRETE PLINTHS

Construction

General: Provide galvanized steel surround at least 75 mm high and 1.6 mm thick, fixed to floor with masonry anchors. Fill with concrete.

Reinforcement: Single layer of F62 fabric.

Concrete: Grade N20.

- Finish: Steel float flush with the surround.

20.5 COMPLETION

20.5.1 GENERAL

Samples

Remove unincorporated samples on completion.

Warranties

General: Confirm the identity of the warrantee with the Engineer. Register with manufacturers as necessary. Retain copies delivered with components and equipment.

Warranty by Whom: Warranty shall be provided by Overall Contractor and specialist Contractor or Supplier

Guarantee of performance: Where the warrantor is a subsidiary of another organisation, submit that organisation's guarantee of the performance of the warranty.

Product warranties: Submit product warranties which are coextensive with or additional to the terms and warranty period of any manufacturer's published warranty, and do not derogate from any warranty implied by law.

Approval of installer: If installation is not by manufacturer, and product warranty is conditional on the manufacturer's approval of the installer, submit the manufacturer's written approval of the installing firm.

Commencement: Commence warranty periods on completion or at acceptance of installation, whichever is later.

Adjustment of warranty period: Where any part of the work is required to be repaired or made good under a warranty, the warranty period:-

- must not terminate until that part has been satisfactorily repaired or made good; and
- in respect of that part, must recommence from the date of completion of the repair or making good.

20 GENERAL REQUIREMENTS

Warranty schedule

M&W Section(s)	Material	Against	Period (years)
130, 200	Aluminium panelling system	Water penetration, warping, deflection, misaligning, weathering, discolouration, corrosion, surface blemish, cracks, scaling and other defects in design, materials and workmanship	10
170,190	Aluminium windows panels louvres and grilles	All defects in design, materials and workmanship	10
240	Cementitious Topping	Cracking, fading, deterioration and all other defects in materials and workmanship	5
150	Curtain Wall System	Water penetration, warping, deflection, misaligning, weathering, discolouration, corrosion, surface blemish, cracks, scaling and other defects in design, materials and workmanship	10
180	Doorsets, hatches and gates	Sagging, warping, misaligning, corrosion and other defects in materials and workmanship	5
120	Fall arrest safety system	All defects in materials and workmanship	5
51	Fire protective coatings	All defects in materials and workmanship	5
50	Fire stop	All defects in materials and workmanship	5
350	Fixed furniture	All defects in design, materials and workmanship	5
290	Floor and wall tiling	Debonding, hollowness and other defects in materials and workmanship	5
60	Fluorocarbon coating system	Discolouration, blistering, cracking, peeling, fading and other defects in materials and workmanship	10
160	Glazing	Water penetration, warping, deflection, misaligning, weathering, discolouration, corrosion, surface blemish, cracks, scaling and other defects in design, materials and workmanship	10
200	GRC Panels and decorative features	Cracks, warping, disintegration, surface blemishes, discolouration and other defects in materials and workmanship	10
182	Ironmongery	All defects in materials and workmanship	5
130, 200	Overall cladding system	Water penetration, warping, deflection, misaligning, weathering, discolouration, corrosion, surface blemish, cracks, scaling and other defects in design, materials and workmanship	10

20 GENERAL REQUIREMENTS

M&W Section(s)	Material	Against	Period (years)
120	Overall roof system including canopy	Water penetration, warping, deflection, ponding, misaligning, weathering, discolouration, corrosion, surface blemish, cracks, scaling and other defects in design, materials and workmanship	10
330	Paintwork	Peeling, cracking, blistering, flaking, fading, discoloration, fungus growth and other defects in materials and workmanship	5
220	Partitions and linings, including toilet and shower partitions	All defects in materials and workmanship	5
90	Precast concrete tiles	All defects in materials and workmanship	10
60	Prefinished metal	Discolouration, blistering, cracking, peeling, fading and other defects in materials and workmanship	10
60	Polyester powder coating system	Discolouration, blistering, cracking, peeling, fading and other defects in materials and workmanship	10
270	Raised access floor	All defects in materials and workmanship	5
181	Roller shutters and grilles	Sagging, warping, misaligning, corrosion and other defects in materials and workmanship	5
320	Sanitary wares, fittings and accessories	All defects in design, materials and workmanship	5
40	Sealants	All defects in materials and workmanship	10
360	Signage System	Discoloration, fading, "yellowing" or other detrimental effect be caused to the sign panel due to heat or ultra-violet radiation either emanating externally or internally from the light source, Peeling, delamination, smudging and other defects in design, materials and workmanship	5
120, 160	Skylight	Ponding, Water Penetration and other defects in design, materials and workmanship	10
340	Stainless steel balustrades, handrails, arm rests, railings, trims and cappings	Rust, surface blemish, cracks, scaling, loosening and other defects in materials and workmanship	15
340	Stainless steel gutters	Rust, surface blemish, cracks, scaling, loosening and other defects in materials and workmanship	5
230	Suspended ceiling system	Discolouration, surface blemish, cracks, misaligning, warping, corrosion, scaling and other defects in materials and workmanship	15
210	Vitreous enamel panels	Discolouration, surface blemishes, corrosion, cracks, warping, scaling and other defects in materials and workmanship	15

20 GENERAL REQUIREMENTS

M&W Section(s)	Material	Against	Period (years)
41	Waterproofing systems	Water penetration, abnormal deterioration, debonding, joint defects, cracks of the constituent components and other defects in materials and workmanship	10

20.5.2 RECORD DRAWINGS

General

Submit record drawings. Show the “as installed” locations of building elements, plant and equipment. Show off-the-grid dimensions where applicable.

Quantity

Provide record drawings in the following quantities and formats:

- Paper prints:
- Number of sets: >
- Reproducible (plastic):
- Number of sets: >
- CAD files:
- Number of copies: >
- Electronic format: >

Accuracy

Documents: Incorporate all modifications made during the progress of the work and testing period. Show any provisions for the future.

Endorsement: Sign and date all record drawings. Keep one set of shop drawings on site at all times expressly for the purpose of marking changes made during the progress of the works.

Drawing layout

Use the same borders and title block as the contract drawings.

20.5.3 OPERATION AND MAINTENANCE MANUALS

General

General: Submit operation and maintenance manuals for installations.

Authors and compilers: Personnel experienced in the maintenance and operation of equipment and systems installed, and with editorial ability.

Subdivision: By installation or system, depending on project size.

Referenced documents: If referenced documents or technical worksections require that manuals be submitted, include corresponding material in the operation and maintenance manuals.

Quantity

Provide operational maintenance manuals in the following forms and quantities:

- Hardcopy:
- Number of copies: >
- Electronic copies:
- Number of copies: >
- Medium: >

Format - hardcopy

A4 size loose leaf, in commercial quality, 4 ring binders with hard covers, each indexed, divided and titled. Include the following features:

- Pagination: Number pages consecutively.
- Cover: Identify each binder with typed or printed title “OPERATION AND MAINTENANCE MANUAL”, to spine. Identify title of project, volume number, volume subject matter, and date of issue.
- Ring size: 50 mm maximum, with compressor bars.

20 GENERAL REQUIREMENTS

- Text: Manufacturers' printed data, including associated diagrams, or typewritten, single-sided on bond paper, in clear concise English.
- Dividers: Durable divider for each separate element, with typed description of system and major equipment components. Clearly print short titles under laminated plastic tabs.
- Drawings: Fold drawings to A4 size and accommodate them in the binders so that they may be unfolded without being detached from the rings. Provide with reinforced punched binder tabs.

Format - electronic copies

Scope: Provide the same material as specified for hardcopy in electronic format.

Printing: Except for drawings required in the **Record drawings** clause provide material that can be legibly printed on A4 size paper.

File format: >

Contents – general

Include the following:

- Table of contents: For each volume. Title to match cover.
- Drawings and technical data: As necessary for the efficient operation and maintenance of the installation.
- Directory: Names, addresses, and telephone and facsimile numbers of principal consultant, subconsultants, contractor, subcontractors and names of responsible parties.
- Equipment descriptions:
 - Name, address and telephone and facsimile numbers of the manufacturer and supplier of items of equipment installed, together with catalogue list numbers.
- Schedules (system by system) of equipment, stating locations, duties, performance figures and dates of manufacture. Provide a unique code number cross-referenced to the record and diagrammatic drawings and schedules, including spare parts schedule, for each item of equipment installed.
- Operation procedures:
 - Manufacturers' technical literature as appropriate.
- Maintenance procedures:
 - Manufacturer's technical literature as appropriate. Register with manufacturer as necessary. Retain copies delivered with equipment.
 - Detailed recommendations for preventative maintenance frequency and procedures.
 - Safe trouble-shooting, disassembly, repair and reassembly, cleaning, alignment and adjustment, balancing and checking procedures. Provide logical step-by-step sequence of instructions for each procedure.
 - Schedule of spares recommended to be held on site, with the names of suppliers, being those items subject to wear or deterioration and which may involve the principal in extended deliveries when replacements are required. Include complete nomenclature and model numbers, and local sources of supply.
- Certificates:
 - Copies of manufacturers' warranties.
 - Certificates from authorities.
 - Product certification.
- Drawings.
 - Record drawings, full size.
- A schedule of all items serviced prior to handover, including all reports prepared by the service engineer.

Timing and quantity

Draft manuals: Submit 2 draft manuals 8 weeks before the date for practical completion to enable the Engineer's staff to familiarise themselves with the installation. Include provisional record drawings and preliminary performance data.

- Format: As for the final manuals, with temporary insertions for items which cannot be finalised until the installation is commissioned and tested.

Revised draft manuals: Submit revised draft manuals 2 weeks before commissioning.

Progressive: For equipment put into service during construction and operated by the Engineer, submit manuals within 2 weeks after acceptance.

Final drafts: Submit for review after completion of commissioning and no later than 2 weeks before the date for practical completion. If available, include certificates from authorities, and warranties.

Final copies: Submit 3 sets of final volumes within 2 weeks after practical completion. Incorporate feedback from review and from training of principal's staff, including preparation and insertion of additional data.

Revisions: Submit 3 sets of loose leaf amendments for insertion in the manuals, incorporating feedback from the maintenance period, within 2 weeks after completion.

20.5.4 TRAINING

General

Operation and maintenance manuals: Use items and procedures listed in the final draft operation and maintenance manuals as the basis for instruction. Review contents with the Engineer's staff in detail.

Format: Conduct training at agreed time, at system or equipment location.

Operation

Immediately after practical completion, explain and demonstrate to the Engineer's staff the purpose, function and operation of the installations.

Maintenance

Immediately after practical completion, explain and demonstrate to the Engineer's staff the purpose, function and maintenance of the installations.

Demonstrators

Qualified manufacturer's representatives who are knowledgeable about the installations.

20.5.5 SPARES

General

Do not provide spares.

>

Schedule: At least 8 weeks before the date for practical completion, submit a schedule of spare parts necessary for maintenance of the installation. State against each item the recommended quantity, and the manufacturer's current price, including for:

- packaging and delivery to site;
- checking receipt, marking and numbering in accordance with the spare parts schedule;
- referencing equipment schedules in the operation and maintenance manuals; and
- painting, greasing and packing to prevent deterioration during storage.

20.5.6 TOOLS

General

General: At practical completion, supply 2 complete sets of special tools and portable indicating instruments necessary for operation and maintenance of equipment together with suitable means of identifying, storing and securing the tools and instruments. Include instructions for use.

20.5.7 COMMISSIONING

Reports

Submit reports indicating observations and results of tests and compliance or non-compliance with requirements.

Notice

Give sufficient notice for inspection to be made of the commissioning of the installation.

20.5.8 COMPLETION TESTS

General

Carry out acceptance tests and final tests.

Functional checks

Carry out functional and operational checks and make adjustments for the correct operation of safety devices.

20.5.9 CLEANING

General

Immediately prior to handover, Clean the following:

- >

20.5.10 DEFECTS LIABILITY

General

General: During the defects liability period, carry out periodic inspections and maintenance work as recommended by manufacturers of supplied equipment, and promptly rectify faults.

Emergencies: Attend emergency calls promptly.

Annual maintenance: Carry out recommended annual maintenance procedures at end of defects liability period.

Maintenance program

Submit details of maintenance procedures and program, relating to installed plant and equipment, 6 weeks before the date for practical completion. Indicate dates of service visits. State contact telephone numbers of service operators and describe arrangements for emergency calls.

Site control

Report to the Engineer's designated representative on arriving at and before leaving the site.

Maintenance records

General: Submit, in binders which match the manuals, loose leaf log book pages designed for recording completion activities including operational and maintenance procedures, materials used, test results, comments for future maintenance actions and notes covering the condition of the installation. Include completed log book pages recording the operational and maintenance activities performed up to the time of practical completion.

Number of pages: The greater of 100 pages or enough pages for the maintenance period and a further 12 months.

Certificates: Include test and approval certificates.

Service visits: Record comments on the functioning of the systems, work carried out, items requiring corrective action, adjustments made and name of service operator. Obtain the signature of the principal's designated representative.

Referenced documents: If referenced documents or technical worksections require that log books or records be submitted, include this material in the maintenance records.

Certification: On satisfactory completion of the installation, submit certificates stating that each installation is operating correctly.

21 Package Definitions

21	PACKAGE DEFINITIONS
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21.1 GENERAL

21.1.1 Cross Reference By Worksection

General

Read with Table of Contents.

This section outlines the particular worksection in which an item, component or assembly may be found.

No.	Worksection	Item/Component/Assembly
	Preliminaries	
10	Quality	<ul style="list-style-type: none"> • Quality system schedule • Document Control • Purchasing • Installation
20	General Requirements	<ul style="list-style-type: none"> • Regulatory Authority's Approval • Contract Documents • Design • Services Co-ordination • Building Penetrations • Concrete Plinths • Warranty Schedule • Record Drawings • Operation & Maintenance Manuals
21	Package Definitions	<ul style="list-style-type: none"> • By Worksection • By Item/Component/Assembly
	General Work	
30	Insulation & Barriers	<ul style="list-style-type: none"> • Aluminium Composite Film • Acoustic Tissue
40	Adhesives, Sealants & Fasteners	<ul style="list-style-type: none"> • Adhesive <ul style="list-style-type: none"> - Mastic • Elastomeric Sealants <ul style="list-style-type: none"> - Polyurethane - Polysulphide - Acrylic - Silicone • Fasteners <ul style="list-style-type: none"> - Powder Actuated - Steel Nails - Bolts - Nuts - Screws
41	Waterproofing	<ul style="list-style-type: none"> • Membranes • Tanking • Wet Area Waterproofing System • Membrane Roofing

21 Package Definitions

No.	Worksection	Item/Component/Assembly
50	Fire Stopping	<ul style="list-style-type: none"> • Fire Stop Mortars • Fibres • Fire Stop Sealants • Fire Stop Foams • Fire Stop Putty • Fire Stop Collars • Fire Stop Pillows
51	Sprayed Mineral Fire Protection	<ul style="list-style-type: none"> • Base • Binding Agent • Fillers • Metal Components • Steel Wire Mesh
60	Metals & Prefinishes	<ul style="list-style-type: none"> • Metals • Electroplating • Anodising • Metal Spraying • Powder Coating • Pre Painting
70	Heavy Duty Galvanised Coating	<ul style="list-style-type: none"> • Hot Dipped Galvanised Coating
	Structure Carcass Work	
90	Concrete Finishes	<ul style="list-style-type: none"> • Surface Modifiers • Unformed Surfaces • Formed Surfaces
100	Brick & Block Construction	<ul style="list-style-type: none"> • Bricks & Blocks • Brickwork & Blockwork • Facework • Cavity Work • Control of Movement • Reinforced & Grouted Blockwork
110	Stone Masonry	<ul style="list-style-type: none"> • Natural Stone <ul style="list-style-type: none"> - Granite - Limestone - Slate
	Enclosure Work	
120	Roofing	<ul style="list-style-type: none"> • Tiling • Sheet Metal Tiling • Sheet Metal Roofing & Cladding • Copper Roofing • Fibre Cement Roofing • Plastic Sheet Roofing • Suspended Fabric Roofing • Roof Ventilators • Roof Plumbing

21 Package Definitions

No.	Worksection	Item/Component/Assembly
130	External Cladding	<ul style="list-style-type: none"> • Fibre Cement Cladding • Compressed Fibre Cement Cladding • Metal Panel Cladding • Louvred Sunscreens
140	Stone Cladding	<ul style="list-style-type: none"> • Marble • Granite • Mortar
150	Curtain Walls	<ul style="list-style-type: none"> • Weather Seals • Panels & Facings • Spandrels • Containment Devices • Fire Stopping
160	Glazing	<ul style="list-style-type: none"> • Float Glass • Fire Resistant Glass • Safety Glass • Ceramic Coated Glass • Opacified Glass • Low Emissivity Coatings • Toughened Glass • Annealed Glass • Structural Glazing • Mirrors • Glazed Shower Screen • Partition Glazing
170	Windows	<ul style="list-style-type: none"> • Window Assemblies • Insect Screens • Security Window Grilles
180	Doors & Hatches	<ul style="list-style-type: none"> • Timber Doors & Frames • Sliding Door Frames • Steel Doors & Frames • Frameless Glass Doors • Access Hatches
181	Roller Shutters & Grilles	<ul style="list-style-type: none"> • Overhead Doors • Roller Shutters • Fire Roller Shutters • Roller Grilles
182	Doors & Window Hardware	<ul style="list-style-type: none"> • Hinges • Keying • Locks & Latches • Door Controllers • Door Bolts • Accessories
190	Louvres	<ul style="list-style-type: none"> • Louvre Assemblies • Louvred Sunscreen • Insect Screens • Bird Mesh Screens

21 Package Definitions

No.	Worksection	Item/Component/Assembly
200	Internal Cladding	<ul style="list-style-type: none"> • Platerboard Panelling • Fibre Cement Panelling • Pre-finished Fibre Cement Panelling • Metal Panelling • Calcium Silicate Board Panelling • Access Panels
210	Vitreous Enamel Panels	<ul style="list-style-type: none"> • Heavy Gauge VE Panels • Light Gauge VE Panels
220	Partitions	<ul style="list-style-type: none"> • Partition Panels <ul style="list-style-type: none"> - Plasterboard - Fibrous Plaster Sheet - Glass Fibre Plasterboard - Steel Sandwich Panels - Coated Steel - Stainless Steel - Composite Panels • Toilet & Shower Cubicles
Finishing Work		
230	Suspended Ceiling	<ul style="list-style-type: none"> • Plasterboard Panels • Fibrous Plaster Tiles • Mineral Fibre Tiles • Glass Fibre Panels • Fibre Cement • GRC • Metal Ceilings • Glass • Plywood
240	Cementitious Topping	<ul style="list-style-type: none"> • Granolithic Toppings • Waterproof Cement Toppings • "No Fines" Topping • Composite Stone Toppings
250	Terrazzo	<ul style="list-style-type: none"> • Resin Terrazzo
260	Granite Flooring	<ul style="list-style-type: none"> • Granite • Tolerances • Slip Resistance
261	Tactile Paving	<ul style="list-style-type: none"> • Granite Tiles • Homogeneous Unglazed Ceramic Tiles • Steel Tiles
270	Access Floors	<ul style="list-style-type: none"> • Pedestals • Stringers • Panels • Accessories

21 Package Definitions

No.	Worksection	Item/Component/Assembly
280	Plastering	<ul style="list-style-type: none"> • Dash Coat • Handwall Gypsum Plaster • White Set Plaster • Cement Render • Waterproof Render • Vermiculite Plaster • Self Coloured Render
281	GRG	<ul style="list-style-type: none"> • GRC • Metallic Reinforcement
290	Tiling	<ul style="list-style-type: none"> • Tiles & Accessories • Adhesives • Mortar • Grout • Joints
300	Resilient Finishes	<ul style="list-style-type: none"> • Sheet & Tiles • Seamless Finishes
310	Gratings	<ul style="list-style-type: none"> • Drainage Channels • Gratings • Floor Gullies • Rainwater Outlet • Open Grid Flooring • Tree Gratings
320	Plumbing & Sanitary Fixtures	<ul style="list-style-type: none"> • Sanitary Fixtures • Automatic Hand Dryer
330	Painting	<ul style="list-style-type: none"> • Painting to:- <li style="padding-left: 20px;">- Concrete <li style="padding-left: 20px;">- Plaster/Render <li style="padding-left: 20px;">- Steel Work <li style="padding-left: 20px;">- Metalwork Fixtures/Assemblies
340	Metal Fixtures	<ul style="list-style-type: none"> • Platform & Walkways • Handrail & Balustrades • Service Gates • Metal Stairs • Fixed Ladders • Corner Protection
Commissioning Work		
350	Furniture & Fittings	<ul style="list-style-type: none"> • Screens, Barriers • Curtains, Blinds • Containers, Bins, Cabinets • Shelf Units • Display Surfaces • Work Stations • Fitment • Bench Top & Vanities • Loose Furniture

21 Package Definitions

No.	Worksection	Item/Component/Assembly
360	Signs & Displays	<ul style="list-style-type: none"> • Changeable Letter Systems • Illuminated Signs • Plaques
	External Work	
370	External Paving	<ul style="list-style-type: none"> • Interlocking Pavings • Edging • Surface Drainage
380	Fencing	<ul style="list-style-type: none"> • Gates • Chainwire Barriers • Welded Fencing • Wheel Stops • Bollards

21.2 GENERAL

21.2.1 Cross References By Item/Component/Assembly

Item/Component/Assembly	By Worksection
Access Panels	200 Internal Cladding
Accessories	100 Brick & Block Construction
Access Hatch	180 Doors & Hatches
Accessories : Glass	160 Glazing
Acoustic insulation for ceilings/soffits	30 Insulation & Barriers
Acoustic Panels	230 Suspended Ceilings
Acoustic Tissue	30 Insulation & Barriers
Adhesive Types	40 Adhesive, Sealants & Fasteners
Advertising	360 Signs & Display
AFC Service Gates	340 Metal Fixtures
Aluminium/Alloys	60 Metals & Prefinishes
Aluminium Baffles	230 Suspended Ceilings
Aluminium Composite Film	30 Insulation & Barriers
Aluminium Panels	230 Suspended Ceilings
Aluminium Structures	340 Metal Fixtures
Anodising	60 Metal & Prefinishes
Asphalt Tanking	41 Waterproofing
Bird Mesh Screens	190 Louvres
Bituminous Roofing System	41 Waterproofing
Bollards	380 Fencing
Brazing	60 Metal & Prefinishes
Brick	100 Brick & Block Construction
Bulk Insulation	30 Insulation & Barriers
Bush Hammered Finish	90 Concrete Finishes
Chain Wire Fencing	380 Fencing
Coated Steels	60 Metal & Prefinishes
Collars	50 Fire Stopping
Components Standard	182 Door/Window Hardware

21 Package Definitions

Item/Component/Assembly	By Worksection
Composite Stone Toppings	240 Cementitious Toppings
Concrete Block	100 Brick & Block Construction
Concrete Plinths	20 General Requirements
Copper/Alloys	60 Metal & Prefinishes
Document Control	10 Quality
Door Controllers	182 Door & Window Hardware
Drainage Channel Gratings	310 Gratings
Duct Access Hatches	180 Doors/Hatches
Elastomeric Sealants	40 Adhesives, Sealants & Fasteners
Electroplating	60 Metal & Prefinishes
Entrances/Links	181 Roller Shutters & Grilles
Exposed Aggregate Finish	90 Concrete Finishes
External Fencing/Railings	370 External Paving
External Render on Concrete/Blockwork	280 Plastering
External Render with Pre Cast Coping Stones	280 Plastering
External Tactile Routes	380 External Paving
Fabricated Metal Components	60 Metals & Prefinishes
Fall Arrest System	120 Roofing
Fasteners	40 Adhesives, Sealants & Fasteners
Fibres	50 Fire Stopping
Fibre Cement Panels	230 Suspended Ceilings
Fibrous Plaster Ceiling Tiles	230 Suspended Ceilings
Finished Floors to Non Public Areas	240 Cementitious Toppings
Finishes to Metals	60 Metals & Prefinishes
Firestop Mortars	50 Fire Stopping
Firestop Sealants	50 Fire Stopping
Flashings	120 Roofing
Float Finish	90 Concrete Finishes
Floorgullies	310 Gratings
Fire Rollers Shutters	181 Roller Shutters & Grilles
Floormats	260 Granite Flooring
Formed Surfaces	90 Concrete Finishes
Frameless Glass Doors	180 Doors & Hatches
Gates	380 Fencing
Glass Doors	180 Doors & Hatches
Glass Type	160 Glazing
Glazed Ceramic Tiles	290 Tiling
Grid Flooring to Ventshafts	310 Gratings
Granite Cladding	140 Stone Cladding
Granite Flooring - Accessories	260 Granite Flooring
Granite Flooring Types & Location	260 Granite Flooring
Granolithic Topping	240 Cementitious Toppings
Hand Dryers	320 Plumbing & Sanitary Fixtures
Handrails	340 Metal Fixtures/Assembly
Hatches Wall/Floor Public	180 Doors/Hatches
Heavy Gauge VE Panels	210 Vitreous Enamel Panels
Hinges	128 Door & Window Hardware

21 Package Definitions

Item/Component/Assembly	By Worksection
Homogenous Floor Tiles	290 Tiling
Hot Dipped Galvanising	70 Heavy Duty Galvanized Coatings
Illuminated Signs	360 Signs & Displays
Interlocking Powers	370 External Paving
Insect Screens	190 Louvres
Internal Louvre Screws/Frames	340 Metal Fixtures/Assembly
Internal & External Locations	230 Suspended Ceilings
Ironmongery	182 Door/Window Hardware
Keying	182 Door/Window Hardware
Ladders	340 Metal Fixtures
Letter Boxes	350 Miscellaneous Furniture
Light Gauge VE Panels	210 Vitreous Enamel Panels
Maintenance	370 External Paving
Marble	140 Stone Cladding
Membranes	30 Insulation & Barriers
Membranes Roofing	41 Waterproofing
Metal Ceilings	230 Suspended Ceilings
Metal Panel Cladding	130 External Cladding
Metal Panelling	200 Internal Cladding
Metal Roofing to Links, Entrances, Linkway	120 Roofing
Metal Spraying	60 Metal & Prefinishes
Metal Stairs	340 Metal Fixtures
Mortars	100 Brick & Block Construction
Natural Stone	110 Stone Masonry
Operation & Maintenance Manuals	20 General Requirements
Overclad Doors/Frames	180 Doors/Hatches
Overhead Doors	181 Roller Shutters & Grilles
Painting to : Concrete	330 Painting
Painting to : Metalwork Fixtures/Assemblies	330 Painting
Painting to : Plaster/Render	330 Painting
Painting to : Steelwork	330 Painting
Plant Material	370 External Paving
Plasterboard	370 External Paving
Powdercoating	60 Metals & Prefinishes
Pre-Installation Conference	20 General Requirements
Precast Concrete Copings At Grade	90 Concrete Finishes
Preparation	370 External Paving
Proprietary/Custom System	230 Suspended Ceilings
Prototype	20 General Requirements
Public Area Seats/Benches	350 Miscellaneous Furniture
PVF2	60 Metals & Prefinishes
Raised Floor	270 Access Floors
Roof Insulation	30 Insulation & Barriers
Roof Membrane System	41 Waterproofing
Roof Outlets/Rainwater Outlets	310 Gratings
Roller Shutters	181 Rollers Shutters & Grilles
Roller Grilles	181 Rollers Shutters & Grilles

21 Package Definitions

Item/Component/Assembly	By Worksection
Sanitary Fittings	320 Sanitary & Plumbing Fixtures
Screeding	90 Concrete Finishes
Sealants	50 Fire Stopping
Sealants	160 Glazing
Sealant Types	40 Adhesives, Sealants & Fasteners
Sheet Metal Roofing	120 Roofing
Shower Fittings	320 Sanitary & Plumbing Fixtures
Shutters - Fire Resistant	181 Rollers Shutters & Grilles
Signage - Public/Non Public	360 Signs & Display
Silicone	40 Adhesives, Sealants & Fasteners
Stair Nosing Tiles	290 Tiling
Staircase/Landing Balustrade/Railings	340 Metal Fixtures/Assembly
Stainless Steel Edge Trim Floor Panels	340 Metal Fixtures/Assembly
Steel Door/Frames	180 Doors/Hatches
Steel/Stainless Steel	60 Metals & Prefinishes
Service Gates	340 Metal Fixtures/Assembly
Substrate to Granite Flooring	240 Cementitious Toppings
Substrate to Roofing	120 Roofing
Surface Drainage	310 External Paving
Tanking	41 Waterproofing
Tiling Accessories	290 Tiling
Toilet Accessories	320 Sanitary & Plumbing Fixtures
Toilet & Shower Cubicles	220 Partitions
Wall Insulation	30 Insulation & Barriers
Wall Tiles	100 Brick & Block Construction
Warranty Schedule	20 General Requirements
Weather Seals	150 Curtain Wall
Welding	60 Metal & Prefinishes
Welded Fencing	380 Fencing
Wheel Stops	380 Fencing
Wet Area Waterproofing	41 Waterproofing
Vinyl Sheeting	300 Resilient Finishes

30 INSULATION AND BARRIERS

30.1 GENERAL

30.1.1 CROSS REFERENCES

General

Refer to the General requirements worksection.

Associated worksections

Refer to the following worksections:

	Suspended Ceilings
	Roofing
	Cladding
	Lining
	Metals and Prefinishes.
	>

30.1.2 STANDARDS

Installation of mineral wool insulation

Comply with the Industry Code of Practice for the Safe Use of Glass Wool and Rock Wool Insulation available from FARIMA, (the Fibreglass and Rockwool Insulation Manufacturer's Association of Australia) 4/5 Lower Wycombe Road, Neutral Bay, NSW 2089, Australia.

Fire Resistance: Incombustible to BS 476, Part 4.

30.1.3 EQUIPOTENTIAL BONDING REQUIREMENTS (EPB)

Cross Refer: section 20.2.7 'Design' of the General Requirements.

30.1.4 TOUCH VOLTAGE PROTECTION

Cross Refer: section 20.2.7 'Design' of the General Requirements.

30.1.5 DESIGN

Drawings

Contract drawings show generic design principles and design intent only.

30.1.6 INTERPRETATION

Definitions

Membrane material: Flexible material normally used for waterproofing, vapour proofing or thermal reflectance.

Mineral wool (including glasswool and rockwool): Entangled mat of fibrous non-crystalline material derived from inorganic oxides or minerals, rock, slag or glass, processed at high temperatures from a molten state.

30.1.7 TESTS

General

Carry out all tests in accordance with section 20.3.2 'Tests' of the General Requirements.

30.1.8 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of the following before they are covered up or concealed:

- Membranes.
- Vapour barriers.
- Insulation.

Hold Points

Completion of confirmation prototype.

Corrosion

Cross refer: General Requirements clause 20.4.1.

30.1.9 SAMPLES

General

Submit samples of each of the following in accordance with section 20.3.4 'Samples', of the General Requirements.

No of samples: 3.

- Each type of proposed insulation.
- Each type of proposed barrier showing how it will be jointed and fixed.
- Each fixing used in securing both insulation and barriers.

Size of samples

- Finishes showing joints: minimum 1.0m sq.
- Linear samples : minimum 600mm.
- Unjointed, non linear, materials: minimum 600mm sq.

No of samples: 3.

Label each sample giving the brand name and product name, manufacturer's code reference and date of manufacture.

30.1.10 PROTOTYPES

General

Construct all prototypes in accordance with the requirements of Section 20.3.5, 'Prototypes' of the General Requirements.

Confirmation Prototype

Provide a confirmation prototype of all insulation and barrier installations

Location: As agreed with the Engineer.

Minimum size: 2.0m x 2.0m.

Incorporating:

- Horizontal and vertical joints.
- Penetrations.
- Edge details as directed by the Engineer.

Retain all prototypes until the completion of the works or as directed by the Engineer.

Incorporate accepted prototypes into the work as directed by the Engineer.

30.1.11 SUBMISSIONS

General

Make all submissions in accordance with the requirements of section 20.3.6, 'Submissions' of the General Requirements.

Subcontractor

Submit name and contact details of proposed suppliers and specialist installer(s).

Manufacturers' information

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with section 3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No of copies to be submitted: 3.

Test Reports

Submit copies of current test reports, and certification, including drawings of tested details, in accordance with section 3.2, 'Tests' of the General Requirements.

No of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with section 20.3.6 'submissions' of the General Requirements.

30.2 MATERIALS AND COMPONENTS

30.2.1 MATERIALS AND COMPONENTS

30.2.2 MATERIALS

General

Toxic materials: Use materials which are certified free of asbestos and lead, or any other known toxin, and free of, nor requiring the use of, toxic solvents.

Do not use products which give off toxic emissions in the event of a fire.

Do not use materials which contain known carcinogenics.

Confirm that materials used in conjunction are compatible with one another, the substrates on which they are used, and all adjacent materials in the completed building.

Corrosivity: Non-corrosive.

Bulk insulation

Mineral wool blankets and cut pieces: To AS/NZS 4851, Section 8.

Mineral wool in loose fill: To AS 2461.

Membrane material

Aluminium composite film:

- Type: double sided light weight reflective metallised aluminium.
- Thickness: 5 mil (150 microns) thickness.
- Puncture propagation and tear resistance: To ASTM D-2582.
- Tensile strength To ASTM D-882.
- Elongation percentage: To ASTM D-882.

Acoustic tissue:

- To: ASTM C423-90a and E795-91.
- Material: glass fibre.
- Type: non woven sound absorbent.
- Thickness: 0.2 mm thick.
- Weight 61g/m².
- Colour:>
- Tensile strength not less than 130N/50 mm 2%.
- Elongation: less than 2% at maximum tensile strength.
- Fire Rating: Class O.

Fasteners and supports

Galvanized steel.

Mesh support to acoustic insulation

Wire netting: To AS 2423.

- Size: 45 mm mesh x 1 mm diameter.

Welded safety mesh: To AS/NZS 4389.

Expanded metal mesh:

- Size: 22 x 57 x 2.0 mm thickness.
- Material: Aluminium.
- Finish: Powder coated.
- >
- Colour: Black.

>

30.3 EXECUTION

30.3.1 INSTALLATION

General

Applicators must be licensed by the insulation and barrier manufacturer(s) to install the insulation and barriers.

Bulk insulation

Standard: To AS 3999 or AS 4075.

Batts and rigid sheets:

- Fit tightly between framing members. If support is not otherwise provided, fix diagonal strands of stainless steel wire to the framing members at 600mm centres and stretch tight.
- Lay with tight interlocking butt joints spot bonded with an adhesive approved by the insulation manufacturer and accepted by the Engineer.

Reflective foil laminate

Fixing: To steel or aluminium: Double sided pressure sensitive tape.

Overlap (minimum): 150 mm and adhesive fix.

30.3.2 ACOUSTIC INSULATION

General

Location >

Materials

Bulk insulation:

- Type: >
- Thickness (mm): >
- Density >
- Fire rating: Non-combustible to BS 476: part 4.

Installation

- Encase insulation material:
- Upper surfaces: -reflective aluminium foil.
-Acoustic tissue.
- Lower surfaces: Acoustic tissue.

Support and fixing

- Expanded metal mesh.
- >

30.3.3 WALL INSULATION

General

Location: >

Materials

Bulk insulation:

- Type: >
- R-value: >
- Thickness (mm): >
- R_w rating: >
- Class: >
- Vapour barrier: >
- Fire rating: Non-combustible to BS 476: part 4.

Installation

Support and fixing: >

30.3.4 ROOF INSULATION

General

- Location: The whole of the roof area
- >

Materials

Bulk insulation:

- Type: >
- R-value: >
- Thickness (mm): >
- R_w rating: >
- Class: >
- Vapour barrier: >
- Fire rating: >

Installation

Support and fixing: >

Sound insulation: Install over the roof support frame, reflective thermal insulation (if any), and mesh support, so that the blanket contact with the underside of the metal roofing sheets complies with the manufacturer's recommendations.

Mesh support to roof insulation

Locations: Provide mesh support to

- vapour barrier or reflective thermal insulation membranes laid over roof framing members which are spaced at more than 900 mm centres; and
- blanket type thermal insulation laid over roof framing members as sound insulation to metal roofing.

Installing wire netting: Lay over the roof framing providing sufficient slack or sag between members to suit the application.

Fixing wire netting: Wire to steel frame.

Installing welded safety mesh: To AS 4389.

30.3.5 COMPLETION

General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Operation and Maintenance Manual

On completion submit an Operation and Maintenance Manual in accordance with item 20.5.3 'Operation and Maintenance Manuals' of the General Requirements.

Include:

- A completed certification document endorsed by the manufacturer confirming that all insulation has been correctly installed and is in compliance with this specification.

Protection

On or before completion of the works, or before joining up to other surfaces, remove all materials used as a means of protection.

Damage

Replace damaged items with new.

Warranties

Warrant the materials and workmanship as part of the overall assembly in which the insulation and/or barrier is employed using the Authority's standard warranty form for the period(s) stated in item 20.5.1 'Warranties' of the General Requirements.

Record drawings

Provide record drawings in accordance with item 20.5.2, Record Drawings, of the General Requirements.

30.3.6 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

40 ADHESIVES, SEALANTS AND FASTENERS

40.1 GENERAL

40.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows:- Civil and Structural Specification, Sections >

- Concrete Finishes
- Glazing
- Structural Glazing
- Metals and Prefinishes
- Curtain walls
- >

Details of specific sealants related to particular locations are given in individual worksections.

40.1.2 CIVIL DEFENCE (CD) REQUIREMENTS

General

Where stations are identified as having Civil Defence (CD) requirements, refer to the CD Design Criteria for requirements and information relating to the upgrading of fixing methods for CD stations.

40.2 QUALITY

40.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of the following:

- Joints completed and ready for sealants.
- >

Hold points

- Completion of first sealed joint.
- Any request for a pull-out test on a fastener.
- >

Corrosion

Cross refer: General Requirements clause 20.4.1.

40.2.2 SAMPLES

General

Submit samples of each of the following in accordance with section 20.3.4 'Samples', of the General Requirements.

No of samples: 3.

Size of samples:

- Bolts and fastenings: items to be used.
- Formed joints: 600mm length.

40.2.3 PROTOTYPES

General

Construct all prototypes in accordance with the requirements of Section 20.3.5, 'Prototypes' of the General Requirements.

Confirmation Prototype

Provide a confirmation prototype of all sealant adhesive and fastening installations.

Location: As agreed with the Engineer.

Incorporating: Components as directed by the Engineer.

Retain all prototypes until the completion of the works or as directed by the Engineer.

Incorporate accepted prototypes into the work as directed by the Engineer.

40.2.4 TESTS

Carry out all tests in accordance with Section 20.3.2 'Tests' of the General Requirements.

Installed sealant tests

Sampling: For each sealant test take 3 samples of installed and cured sealant, each at least 50 mm long, from completed joints.

Testing: Test to the standard applicable to the sealant type.

Reinstatement: Make good the joints from which the samples were taken.

Installed sealant tests schedule

Item to be tested	Property to be tested	Applicable standard
>	>	>
>	>	>
>	>	>

Structural fixings tests

Sampling: Sample structural fixings at the rate of one item per 100 fixings, or part thereof, of each type.

Testing: Test to determine whether the fixing metals are of the material, grade or designation required.

Tensile tests: To BS 5080:1.

Shear tests: To BS 5080:2.

Structural fixings tests schedule

Item to be tested	Property to be tested	Applicable standard
>	>	>
>	>	>
>	>	>

Civil Defence Requirements

Test all fixings as required by the Civil Defence Design Criteria issued by Building and Construction Authority.

40.2.5 SUBMISSIONS

General

Submit in accordance with section 20.3.6, 'Submissions' of the General Requirements.

Subcontractor

Submit name and contact details of proposed suppliers and specialist installer(s).

Engineering Endorsement

Submit calculations and drawing from a Singapore licensed Professional Engineer for all adhesives and fasteners showing, but not limited to, the following:-

Compliance with all relevant Singapore legislation and regulations.

Manufacturers' information

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with section 20.3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No of copies to be submitted: 3.

Test Reports

Submit copies of current test reports, and certification, including drawings of tested details, for each specified or proposed fire-stopping system in accordance with Section 20.3.2, 'Tests' of the General Requirements.

Submit PSB test reports.

No of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with section 20.3.6 'Submissions' of the General Requirements.

Notice

Give notice if substrates are not suitable for sealants.

40.3 MATERIALS AND COMPONENTS

General

Confirm that materials used in conjunction are compatible with one another, the substrates on which they are used, and all adjacent materials in the completed building.

40.3.1 HAZARDOUS MATERIALS

General:

- Do not provide materials which, when subject to fire conditions, will emit excessive smoke or dangerous fumes.
- Ensure materials are free of, or do not require the use of, toxic solvents.
- Do not use materials which contain known carcinogenics.

40.3.2 ADHESIVES

Shelf life

Ensure materials used have not exceeded their shelf life.

Performance

Provide adhesives capable of:-

Transmitting imposed loads, sufficient to ensure the rigidity of the assembly, and which will not cause discolouration of finished surfaces or have any detrimental effect on materials with which it comes into contact.

- Performing as specified when in contact with run-off from other materials.
- Performing as specified for the lifetime specified in individual work sections.
- Performing as specified in the ambient climatic conditions of Singapore.

Adhesive types

Mastic adhesive: To AS 2329.

>

Very high bond pressure sensitive tapes:

- Minimum Peel strength: To ASTM D-3330.
- Minimum Normal Tensile (T-block): To ASTM D-897.
- Minimum Dynamic Shear: To ASTM D-1002.

Demonstrate U.V. resistance for external applications.

Do not use silicone sealants as adhesives.

40.3.3 SEALANTS

Shelf life

Ensure materials used have not exceeded their shelf life.

General

Provide sealants which will:-

- fully adhere to the materials either side of the joint.
- not react chemically with the materials which they come into contact with.
- not discolour adjacent finished surfaces.
- not sag or shrink in use.
- remain elastic and weatherproof.
- accommodate the range of movement anticipated for their location but in no case less than 25%.
- have no adverse effects after 5 weeks exposure to 15-25 E-Vitons of UC Energy at 70°C.

- have no adhesion or coefficient failures, nor significant changes after 8000 hours, when subjected to accelerated aging tests (ASTM E-42 Method E).

Sealant colour:

- To match adjacent surfaces.
- As specified on the drawings.

Elastomeric sealants

Sealing compound (polyurethane, polysulphide, acrylic):

- Single component: To ASTM C920.
- Multi component: To TT-S-00227E.

Sealing compound (silicone):

- Single component: To TT-S-001543A.
- Multi component: To TT-S-00227E.

Polysulphide sealants:

- One-part: To BS 5215.
- Two-part: To BS 4254.

Multi component epoxidized polyurethane sealant:

- Adhesion in peel: 6.3kg.
- Hardness: 25 (shore A) after 7 days at 24°C. Average 35 after 5 years.
- Pot life: Maximum 7 hours.
- Tack free time: Less than 72 hours.

Waterproofing Systems: Sealants for Joints

Silicone, polyurethane or polysulphide, complying with SS CP 82.

40.3.4 BACKING RODS

Provide backing rods to sealants as required by the manufacturer's printed instructions.

Material: polyethylene foam.

Size: to suit the joint width but in no case smaller than the joint width + 25%.

40.3.5 BOND BREAKER

Use bond breaker tape where backing rods are not provided to prevent adhesion to the rear face of a joint.

Material: As recommended by the sealant manufacturer.

40.3.6 FASTENERS

Performance

Provide fasteners capable of transmitting the loads imposed, and sufficient to ensure the rigidity of the assembly.

Provide fasteners equal or greater than the material strength and corrosion resistance of the lowest of the materials being joined.

Use tamper proof fixings where they will be accessible to the general public.

For stations designated as Civil Defence shelters, provide fixings in compliance with the Civil Defence Design Criteria issued by Building and Construction Authority.

All fasteners and associated brackets shall be corrosion resistant. The use of untreated mild steel, or cadmium plated steel will not be acceptable.

General

Masonry anchors: Purpose-made proprietary expansion or chemical types.

Plain washers: To AS 1237.1.

- General: Provide washers to the heads and nuts of bolts and coach screws.

Plugs: Purpose-made plastic.

Powder-actuated fasteners: To AS/NZS 1873.4.

Steel nails: To AS 2334.

- Length: At least 2½ x the thickness of the member being secured, and at least 4 x the thickness if the member is plywood or building board < 10 mm thick.

Unified hexagon bolts, screws and nuts: To AS/NZS 2465.

Isolate dissimilar materials to prevent galvanic corrosion.

Fastenings to Aluminium (including Aluminium alloys): Aluminium alloys or non magnetic stainless steel.

Fastenings to Stainless Steel: Appropriate stainless steel materials only. Passivate the threads of threaded fastenings.

Bolts

- Coach bolts: To AS/NZS 1390.
- Hexagon bolts Grades A and B: To AS 1110.1.
- Hexagon bolts Grade C: To AS 1111.1.

Nuts

- Hexagon chamfered thin nuts Grades A and B: To AS 1112.4.
- Hexagon nuts Style 1 Grades A and B: To AS 1112.1.
- Hexagon nuts Style 2 Grades A and B: To AS 1112.2.
- Hexagon nuts Grade C: To AS 1112.3.

Screws

- Coach screws: To AS/NZS 1393.
- Hexagon screws Grades A and B: To AS 1110.2.
- Hexagon screws: Grade C To AS 1111.2.
- Hexagon socket screws: To AS 1420 and AS/NZS 1421.
- Machine screws: To AS/NZS 1427.
- Self-drilling screws: To AS 3566.1.
 - Corrosion resistance: Class 2 to AS 3566.2, Table 1.
- Head tapping screws:
 - Crossed recessed countersunk (flat - common head style): To AS/NZS 4407.
 - Crossed recessed pan: To AS/NZS 4406.
 - Crossed recessed raised countersunk (oval): To AS/NZS 4408.
 - Hexagon: To AS/NZS 4402.
 - Hexagon flange: To AS/NZS 4410.
 - Hexagon washer: To AS/NZS 4409.
 - Slotted countersunk (flat - common head style): To AS/NZS 4404.
 - Slotted pan: To AS/NZS 4403.
 - Slotted raised countersunk (oval - common head style): To AS/NZS 4405.

Finishes

- Electroplating:
 - Metric thread: To AS 1897.
 - Imperial thread: To AS 4397.

Galvanizing:

- Threaded fasteners: To AS 1214.
- Other fasteners: To AS/NZS 4680.

Mild steel fasteners: Galvanize where:-

- exposed to weather
- embedded in masonry.

Corrosion resistance

Conform to the **Corrosion resistance table**.

Steel products:

- Distance to water: To the man high water mark.

Corrosion resistance table

Corrosivity category	Situation	Self drilling screws to AS 3566: Class	Threaded fasteners and anchors: Material or minimum local metallic coating thickness (µm)	Powder actuated fasteners: Material or minimum local metallic coating thickness (µm)
Low More than 10 km	Internal	1	Electroplated zinc 4	Electroplated zinc 4

40 ADHESIVES, SEALANTS AND FASTENERS

	External	3	Electroplated zinc or galvanize 30	Stainless 316
Medium 1 to 10 km from water subject to breaking surf	Internal	2	Electroplated zinc 12	Electroplated zinc 12
	External	4	Hot-dip galvanize 50	Stainless 316
More than 50 m from salt water not subject to breaking surf Non-heavy industrial areas				
High 200 to 1000 m from water subject to breaking surf	Internal	3	Electroplated zinc or galvanize 30	Stainless 316
	External	Stainless 316	Stainless 316	Stainless 316
0 to 50 m from salt water not subject to breaking surf Heavy industrial areas				

40.4 EXECUTION

40.4.1 General

Applicators must be licensed by the adhesive, sealant and fastener manufacturer to install the adhesives, sealants and fasteners.

40.4.2 ADHESIVES

General

Do not provide the following combinations:

- Cement based adhesives on metal, painted or glazed surfaces, gypsum based plaster.
- Organic solvent-based adhesives on painted surfaces.
- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- >

40.4.3 SEALANTS

General

Ensure that the surfaces to which the sealant is to adhere have been cleaned of all filler material, dirt, oil, grease and other sealant matter.

Joint width to depth ratio: to match manufacturer's printed instructions but not less than 6mm width and depth.

Mask all adjoining surfaces to prevent contamination from sealants during application. Remove masking and make good on completion.

Apply sealants using methods recommended by the manufacturer.

Bring the sealant flush to the surface of adjoining materials.

Finish sealants 1.0mm below the lowest point where adjoining surfaces are uneven.

Tool sealant to profile:>

40 ADHESIVES, SEALANTS AND FASTENERS

Joint finish schedule

Joint finish	Material	Location
>	>	>
>	>	>
>	>	>

Remove all excess material and spillage and leave adjoining surfaces clean.

40.4.4 FASTENERS

40.4.1 General

Tighten all fixings to the recommended torque using torque wrenches.

Check and confirm the setting of all torque wrenches daily and after every disengagement to allow fixings to be removed.

Washers: Provide washers to the heads and nuts of all bolts. Ensure washers are sized to suit both nuts and bolts.

Use lock-nuts to prevent loosening.

At least one clear thread to show above the nut.

Bolting: protect concrete surfaces when bolt fixing.

Masonry anchors: Use proprietary chemical anchors within 200mm of concrete edges; elsewhere use proprietary, corrosion resistant, expansion anchors.

40.4.5 COMPLETION

General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Protection

Protect all completed sealant on site from damage until handover

On or before completion of the works remove all materials used as a means of protection.

Damage

Replace damaged items with new.

Warranties

Warrant the materials and workmanship as part of the overall assembly in which the adhesive, sealant or fastening is employed using the Authority's standard warranty form for the period(s) stated in item 20.5.1 'Warranties' of the General Requirements.

Operation and Maintenance Manual

On completion submit an Operation and Maintenance Manual in accordance with item 20.5.3 'Operation and Maintenance Manuals' of the General Requirements.

40.4.6 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

41 WATERPROOFING

41.1 GENERAL

41.1.1 CROSS REFERENCES

General

Refer to the General Requirements worksection.

Associated worksections

Refer to the following worksections:

- Cementitious Toppings.
- Gratings.
- Plastering.
- >

41.1.2 DESIGN

Drawings

Contract drawings show generic design principles and design intent only.

41.2 QUALITY

41.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of the following:

- All areas prepared to receive waterproofing.
- All joints prior to sealing.
- Those parts of the waterproofing installation which will be covered up or concealed.

Hold points

Completion of confirmation prototypes.

Completion of all ponding tests.

Corrosion

Cross refer: General Requirements clause 20.4.1.

41.2.2 TESTS

General

Carry out all tests in accordance with Section 20.3.2 'Tests' of the General Requirements.

Physical performance: Submit reports from a testing station accredited by SINGLAS.

Product data: Submit test certificates to show compliance with the requirements of this specification.

Carry out ponding test to all areas as directed by the Engineer to test the watertightness of the waterproofing systems installed. In the event of the failure of the ponding tests, the Contractor shall bear the cost of all necessary remedial works.

Re-test all areas on completion of remedial work following a failed ponding test.

Ponding Tests

Flood all areas subject to a ponding test to the greatest depth of water possible, minimum 50mm.

Retain the water in place for 48 hours.

Dryness Tests

For substrates: To AS 1884 Appendix A.

41.2.3 SAMPLES

General

Submit samples of each of the following in accordance with Section 20.3.4 'Samples', of the General Requirements.

Provide a sample of

- all sheet materials used in the construction of a waterproofing layer.
- The build up of sheet materials including joints between them.
- all waterproof seals.
- all materials used as a flashing.
- All cementitious compounds used to create a waterproof layer.

- All materials and components visible in the completed works.
- All accessories required to complete the waterproofing.

No of samples: 3.

Size

- Sheet samples 600 x 600mm.
- Samples illustrating build-ups: 1.0 x 1.0m.

41.2.4 PROTOTYPES

General

Construct all prototypes in accordance with the requirements of Section 20.3.5, 'Prototypes' of the General Requirements.

Confirmation Prototype

Provide a confirmation prototype of all waterproofing.

Location:	As agreed with the Engineer.
Minimum size (face of panel):	Full size waterproofing panel, or as directed by the Engineer.
Incorporating	<ul style="list-style-type: none">- joints, penetrations and interfacing details as directed by the Engineer.- Support details as directed by the Engineer.- Accessories as required by the Engineer.

Retain all prototypes until the completion of the works or as directed by the Engineer.

Incorporate accepted prototypes into the work as directed by the Engineer.

41.2.5 SUBMISSIONS

General

Make all submissions in accordance with the requirements of Section 20.3.6, 'Submissions' of the General Requirements.

Subcontractors

Submit name and contact details of proposed specialist waterproofing subcontractor(s).

Shop drawings

General: Submit shop drawings in accordance with Section 20.3.6 'Submissions' of the General Requirements.

Submit shop drawings showing, but not limited to, the following information:

- Elevations plans and sections to show the extent of all waterproofing.
- Details of all required joints, penetrations and interfaces.
- Allowances for movement.
- Protection to the completed work.

No of copies to be submitted: As Particular Specification.

Technical Literature

Submit the manufacturer's technical literature for all proprietary materials used and certification that materials comply with the required standards in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No of copies to be submitted: 3.

Test Reports

Submit copies of current test reports, and certification, including drawings of tested details, for each specified or proposed fire-stopping system in accordance with Section 20.3.2, 'Tests' of the General Requirements.

Submit PSB test reports.

No of copies to be submitted: 3.

Report

Waterproofing membranes: Submit a project report on preparation, work-in-progress and completion, including photographic record.

No of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with Section 20.3.6 ‘Submissions’ of the General Requirements.

Submit a method statement for all waterporoofting works.

Notice

Give notice if substrates or penetrants or both are not suitable for fire-stopping.

41.3 MATERIALS AND COMPONENTS

41.3.1 MEMBRANES

General

Shelf life: Ensure materials used have not exceeded their shelf life.

Toxic materials: Use materials which are certified free of asbestos and lead, or any other known toxin, and free of, nor requiring the use of, toxic solvents.

Do not use products which give off toxic emissions in the event of a fire.

Do not use materials which contain known carcinogenics.

Confirm that materials used in conjunction are compatible with one another, the substrates on which they are used , and all adjacent materials in the completed building.

Asphalt tanking membranes

Waterproof 5 mm thick, of bituminoid asphalt materials, reinforced with fabric, with at least one layer in each sheet of an impermeable, non-corroding material.

Single layer membranes

Fix and lap sheets with appropriate proprietary adhesive or by heat welding using a gas torch (“torch on”), self finished or finished with a proprietary surfacing.

Seamless membranes

Membranes applied in liquid or gel form and air cured to form a seamless film.

Cementitious Waterproofing System

>

41.3.2 TANKING

Tanking and under-slab membrane protection

General: Protect the membrane after installation, with a permanent cover of rigid closed cell extruded polystyrene foam boarding with shiplapped edges, adhered to the membrane with a solvent-free or low melt bitumen adhesive. Provide a maximum 6 mm gap at joints between boards.

Material type: >

Thickness: >

Method of fixing: >

Jointing: >

Cover the protection to vertical tanking using a layer of calcium silicate boarding.

Thickness 6mm.

Method of fixing spot bonded to the inner protection layer using an adhesive accepted by the inner layer manufacturer.

Jointing maximumx 6mm gap.

Asphalt tanking installation

Standard: To AS CA55.

Tanking and under-slab membranes

Location: >

Membrane type: A high performance self adhesive rubberised bitumen or polyethylene waterproofing membrane.

Tensile strength To ASTM D882: 40,000 kN/m².

Elongation of membrane ASTM D412: 300%.

Tear resistance ASTM D624: 32N/mm.

Permeance ASTM E96 (12): 2NG/m².s.Pa.

Impact resistance ASTM G14: 12 kg.cm.

Puncture resistance ASTM E154-88:250N.

Resistance to hydrostatic head ASTM D5385: 60.0m.

Lap adhesion @ 23°C ASTM D1876: 683 N/m.

41.3.3 WET AREA WATERPROOFING SYSTEM

Location	>
Type	Fast drying, tar free, one part seamless membrane to ASTM 836-1989.
Tensile Strength	ASTM D412: 3.0 Mpa.
Elongation at break	ASTM D412: 1440%.
Hardness Shore A	ASTM D2240: 30.
Tear Resistance	ASTM D624 Die C: 7.4 kN/m.
Adhesion strength	ASTM C836-89: 1.7kg.cm.
Tensile strength @ 100% elongation	ASTM D412: 0.62 Mpa.
Recovery from 350% elongation	ASTM D412: 98%.
Water absorption after 6 months	ASTM D471: 2.0%.
Vapour permeability	ASTM E96-B: 1.625 grains/hr/ft ² .
Hydrostatic resistance	ASTM D571-2: 0.65MPa.

41.3.4 MEMBRANE ROOFING

Bituminous fabric roofing

Standard: To AS CA55.

Membrane

Type:

Proprietary liquid applied or sheet membrane system which:

- has a current appraisal test report issued by PSB stating that the system is suitable for use as a waterproofing system for use in wet areas, shower recess bases and associated floors and wall/floor junctions which are to be tiled.
- Water Based: comply with SS 374.
- Polyurethane: comply with SS 133.

Sheet membranes: comply with SS374:

- Self-Adhesive
- Torch-On
- Mechanically Fastened.

Cementitious: comply with SS 374.

Membrane Reinforcement

Comply with SS 133 and SS 374.

Type:

- Polyester Film with Glass Fibre Matt.
- Perforated Fibre Glass Matt.
- Non-woven Polyester Fabric.

Roof outlets for membrane roof

General: Proprietary funnel shaped sump cast into the roof slab, set flush with membrane, with a flat removable grating and provision (e.g. clamp ring) for sealing the membrane into the base of the outlet.

Standard: To BS 416.

Material: Cast iron

>

Grating: Domical

>

Bituminous high tensile multilayer roofing system

Number of layers: 3

Material type:

- Base layer: >
- Intermediate layer: >
- Top layer: >

Bonding agent: >

Insulation:	>
Surface protection/finish:	>
Method of laying:	>
Other requirements:	>
Single layer roofing system	
Sheet type:	>
Sheet thickness (mm):	>
Base weight (g/m ²):	>
Tensile strength (minimum) (MPa):	>
Breaking strength (N):	>
Elongation at break (%):	>
Modulus at 300% elongation (MPa):	>
Permeability:	>
Side lap width (mm):	>
End lap width (mm):	>
Method of fixing to deck:	>
Thermal insulation type:	>
Surface finish:	>
Seamless roofing membranes	
Material type:	Liquid applied water based membrane.
Elasticity (%):	
- At maximum stress:	>
- At break:	>
Maximum stress (kPa):	>
Permeability:	>
Method of application:	>
Number of coats:	>
Application rate/coat (L/m ²):	>
Dry film thickness (total) (mm):	>
Surface finish:	>
Reflectivity:	>
Top edge sealing of membrane	
Flashing:	>
Membrane:	>
Sealant:	>

41.4 EXECUTION

41.4.1 General

Applicators must be licensed by the waterproofing manufacturer to install the waterproofing.

41.4.2 SUBSTRATES

Substrates for membranes

General: Apply membranes to dry, smooth, firm, continuous surfaces, clean and free from loose or foreign matter. Provide minimum 50mm 45° coving or fillets on internal corners. Form arris, external corners and edges to match.

Grade substrates to fall to drains without ponding.

Minimum fall: 1:60.

Test all substrates for dryness using an electronic moisture meter accepted by the Engineer.

Ensure all substrates are within the tolerances and smoothness recommended by the manufacturer of the waterproofing system.

Ensure all cracks and honeycombing in the substrate have been rectified to the acceptance of the manufacturer of the waterproofing system.

Where required, apply primers in accordance with the waterproofing manufacturer's instructions.

Installation

Apply all waterproofing in accordance with the manufacturer's instructions.

Turn floor membranes up walls and upstands as shown on the accepted shop drawings and finish to a clean straight line.

Ensure membranes are dressed into roof outlets in line with instructions issued by the manufacturer of the waterproofing and the outlet.

Movement joints

Location: Over movement joints in the substructure.

41.5 COMPLETION

41.5.1 General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Operation and Maintenance Manual

On completion submit an Operation and Maintenance Manual in accordance with Item 20.5.3 'Operation and Maintenance Manuals' of the General Requirements.

Include:

- A completed certification document endorsed by the manufacturer confirming that all waterproofing has been correctly installed and is in compliance with this specification.

Protection

Protect the completed waterproofing until the completion of the works.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

Warranties

Warrant the materials and workmanship using the Authority's standard warranty form for the period(s) stated in Item 20.5.1 'Warranties' of the General requirements.

Record drawings

Provide record drawings in accordance with Item 20.5.2, Record Drawings, of the General Requirements.

41.5.2 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

50 FIRE-STOPPING

50.1 GENERAL

50.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows: Sprayed Mineral Fire Protection.

>

50.1.2 GENERAL STANDARDS

General

Service penetration fire-stopping systems: To provide the required period of fire resistance and be included in the FSSB product listings.

Control joint fire-stopping systems: To provide the required period of fire resistance and be included in the FSSB product listings.

50.1.3 DESIGN

Drawings

Contract drawings show generic design principles and design intent only.

50.2 QUALITY

50.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of the following:

- Service penetrations completed and ready for fire-stopping.

Hold points

- Completion of all confirmation prototypes.
- Finished fire-stopping, before being concealed.
- >

Corrosion

Cross refer: General Requirements Clause 20.4.1.

50.2.2 TESTS

General

Carry out all tests in accordance with Section 20.3.2 'Tests' of the General Requirements.

Materials

To BS 476: Part 20.

50.2.3 SAMPLES

General

Submit samples of each of the following in accordance with Section 20.3.4 'Samples', of the General Requirements.

Sample panels

General: Supply a sample panel of

- each fire-stopping assembly, on representative substrates.
- Installation accessories.

Size: 600 mm run for junction seals and 600 x 600mm area for penetration seals.

No of samples: 3.

50.2.4 PROTOTYPES

General

Construct all prototypes in accordance with the requirements of Section 20.3.5, 'Prototypes' of the General Requirements.

Confirmation Prototype

Provide a confirmation prototype of all fire stopping installations

Location: As agreed with the Engineer.

Incorporating: Perimeter details as directed by the Engineer.

Retain all prototypes until the completion of the works or as directed by the Engineer.

Incorporate accepted prototypes into the work as directed by the Engineer.

50.2.5 SUBMISSIONS

General

Make all submissions in accordance with the requirements of Section 20.3.6, 'Submissions' of the General Requirements.

Subcontractor

Submit name and contact details of proposed suppliers and specialist installer(s).

Shop drawings

General: Submit shop drawings in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Submit shop drawings of all items of furniture showing, but not limited to the following information:

- General arrangements incorporating a numbering system which will allow each item of fire stopping to be separately identified.
- All service penetrations which require fire stopping.
- All items provided by system wide contractors.
- Interfacing details with adjacent finishes and materials.

No of copies to be submitted: As Particular Specification.

Manufacturers' information

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No of copies to be submitted: 3.

Test Reports

Submit copies of current test reports, and certification, including drawings of tested details, for each specified or proposed fire-stopping system in accordance with Section 20.3.2, 'Tests' of the General Requirements.

Submit PSB test reports.

No of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with Section 3.6 'Submissions' of the General Requirements.

Notice

Give notice if substrates or penetrants or both are not suitable for fire-stopping.

50.3 MATERIALS AND COMPONENTS

50.3.1 MATERIALS

General

Shelf life: Ensure materials used have not exceeded their shelf life.

Toxic materials: Use materials which are certified free of asbestos and lead, or any other known toxin, and free of, nor requiring the use of, toxic solvents.

Do not use products which give off toxic emissions in the event of a fire.

Do not use materials which contain known carcinogenics.

Corrosivity: Non-corrosive.

Do not use intumescent materials or rely on intumescent coatings internally.

Confirm that materials used in conjunction are compatible with one another, the substrates on which they are used, and all adjacent materials in the completed building.

Fire-stop mortars

Type: Re-enterable cement-based compound, mixed with water. Non-shrinking, moisture resistant. Insoluble in water after setting.

Setting time: 60 minutes maximum.

Curing time: 24 hours maximum.

Formulated compound of incombustible fibres

Material: Formulated compound mixed with mineral fibres, non-shrinking, moisture resistant. Insoluble in water after setting.

Fibre stuffing

Material:

- Mineral fibre stuffing insulation, dry and free of other contaminants.
- Ceramic fibre stuffing insulation, dry and free of other contaminants.

Standard: >

Sealant: >

Submit the manufacturer's certification that alkaline water contamination will not cause corrosion of metal penetrating items.

Fire-stop composite sheets

Materials >

Fire-stop sealants

Material: Elastomeric sealant. Soft, permanently flexible, non-sag, non-shrinking, moisture resistant. Capable of providing a smoke-tight, gas-tight and waterproof seal when properly installed. Insoluble in water after setting.

Fire-stop foams

Material: Single component compound of reactive foam ingredients, non-shrinking, moisture resistant. Insoluble in water after setting.

Fire-stop putty

Material: Single component, mouldable, permanently flexible, non-shrinking, moisture resistant, intumescent compound which expands on exposure to surface heat gain, forming a high-volume thermally insulating char that closes gaps and voids, resists the turbulence of a severe fire. Capable of being placed by hand to form an immediate fire seal. Insoluble in water after setting.

Fire-stopping materials schedule

Properties	Fire-stopping codes		
	FS1	FS2	FS3
Material or component	>	>	>
Elongation/shrinkage (%)	>	>	>
Potential expansion (minimum)	>	>	>
Adhesion and bond to substrate (kPa)	>	>	>
Compressive strength (kPa)	>	>	>
Density (kg/m ³)	>	>	>
Vapour permeability (ng/Pa.s.m ²)	>	>	>
Air permeability (L/s.m ²)	>	>	>
Durability in service	>	>	>
Surface durability	>	>	>
Toxicity	>	>	>
Recycled content	>	>	>
Re-penetrability	>	>	>
Surface texture	>	>	>
Colour	>	>	>

50.3.2 COMPONENTS

Fire-stop collars

Material: Mechanical device with incombustible intumescent fillers covered with sheet steel jacket. Airtight and watertight.

Fire-stop pillows

Material: Formed self-contained compressible flexible mineral fibre in cloth bags, rated to permit frequent changes in service.

Accessories

Primer: As recommended by manufacturer for substrates on site.

Permanent retaining material: Non-combustible.

- Type: >

Metal lath: >

Installation accessories: Provide clips, collars, fasteners, temporary stops and dams, and other devices required to position, support and contain fire-stopping and accessories.

50.4 EXECUTION

50.4.1 General

Applicators must be licensed by the fire stopping manufacturer to install the fire stopping.

50.4.2 EXECUTION GENERALLY

General

Extent: Fire-stop and smoke-stop interruptions to fire-rated assemblies, materials and components, including penetrations through fire-rated elements, breaks within fire-rated elements (e.g. expansion joints), and junctions between fire-rated elements.

Sequence: Fire-stop after services have been installed through penetrations and properly spaced and supported, after sleeving where appropriate, and after removal of temporary lines, but before restricting access to the penetrations, including before dry lining.

Installer qualifications: Minimum 5 years documented experience in the installation of the following types of fire stopping systems:-

- >

Install fire stopping systems in accordance with the system manufacturer's printed instructions.

Ventilation: Supply extract ventilation for non-aqueous solvent-cured materials.

Density: Apply fire-stopping material to uniform density.

Fire-stopping exposed to view: Finish surfaces to a uniform and level condition.

Cable separation: Maintain.

Protection: Protect adjacent surfaces from damage arising through installation of fire-stopping.

Protect completed fire-stopping from damage arising from other work.

Loose or damaged fire-stopping material: Remove and replace.

Penetrations by pipes and ducts: Allow for thermal movement of the pipes and ducts.

Preventing displacement: Reinforce or support fire-stopping materials with non-combustible materials when:-

- the unsupported span of the fire-stopping materials > 100 mm; or

- the fire-stopping materials are non-rigid (unless shown to be satisfactory by test).

Environmental management: refer to the manufacturers printed health and safety documentation.

Ambient conditions: refer to the manufacturers printed installation data.

Large openings: Provide fire-stopping capable of supporting the same loads as the surrounding element or provide similar structural support around the opening.

Preparation

Cleaning: Clean substrates of dirt, dust, grease, oil, loose material, and other matter which may affect bond of fire-stop material.

Primer: Clean and dry substrates for primers and sealants.

Restraint: Install backing and/or damming materials to arrest liquid material leakage. Remove temporary dams after material has cured.

50.4.3 SYSTEMS

Fibre stuffing

Installation: Compress to 40% of its uncompressed volume.

Fire-stop sealants

Ambient conditions: Do not store or install outside the temperature range recommended by the sealant manufacturer. Do not install when humidity exceeds that recommended by the sealant manufacturer for safe installation.

Fire-stop foams

Ambient conditions: Do not store or install outside the temperature range recommended by the manufacturer.

Installation: Test substrates for adhesion and prime if necessary. Install in compliance with the manufacturer’s recommendations. Place sealant to completely seal junctions with adjacent dissimilar materials.

Fire-stop putty

Ambient conditions: Do not store outside the temperature range recommended by the manufacturer.

Installation: in compliance with the manufacturer’s recommendations.

Fire-stop collars

Installation: in compliance with the manufacturer’s recommendations.

Fire-stop pillows

Ambient conditions: Do not install in conditions outside of the manufacturer’s recommendations.

Fire-stopping systems schedule

Location	Substrate	Penetrants	Fire-stopping code	FRL	Resistance to the incipient spread of fire
Fire walls	>	>	>	>	>
Stair walls	>	>	>	>	>
Room to room partitions - head/slab junction	>	n/a	>	>	>
Room to room partitions	>	metallic pipe and conduit	>	>	>
Room to room partitions	>	non-metallic pipe and conduit	>	>	>
Floors	>	metallic pipe and conduit	>	>	>
Curtain wall, between slab and inner face of curtain wall	>	n/a	>	>	>

Labelling

Label each fire-stopping installation with a permanently fixed tag or sticker containing the following information:

- Manufacturer’s name.
- Name and address of installer.
- Date of installation.
- Additional information as required by statute.

50.5 COMPLETION

50.5.1 COMPLETION SUBMISSIONS

General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Operation and Maintenance Manual

On completion submit an Operation and Maintenance Manual in accordance with item 20.5.3 'Operation and Maintenance Manuals' of the General Requirements.

Include:

- A completed certification document endorsed by the manufacturer confirming that fire-stopped penetrations and control joints have been correctly installed and are in compliance with this specification.
- A schedule of installed fire-stopped penetrations and control joints identifying location of each and period of fire resistance.

Test

Type: Fog tests.

Location: As agreed with the Engineer.

Number: Minimum 5. If any tests fail further tests may be required at the contractor's expense.

Fog unit output: 6.8L/h.

Formulation particle size: 0.5 – 25 microns.

Fogging agent:

Non-toxic.

Non-staining.

Provide heavy fog at 30 ppm with a permissible airborne level concentration of 50 ppm.

Fog at a rate of 4s/2.8m³.

Maintain fog density until inspection is complete.

Failure: if any penetration, joint, or void emits visible fog.

In the event of failure remove the fire stopping in its entirety and re-do. Re-test on completion.

Cleaning

Remove spilled and excess fire-stopping materials without damaging other work.

Protection

Protect all fire stopping on site from damage until handover.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

On or before completion of the works remove all materials used as a means of protection.

Damage

Replace damaged items with new.

Warranties

Warrant the materials and workmanship as part of the overall assembly in which the fire stopping is employed using the Authority's standard warranty form for the period(s) stated in Item 20.5.1 'Warranties' of the General Requirements.

Record drawings

Provide record drawings in accordance with Item 20.5.2, Record Drawings, of the General Requirements.

50.5.2 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

51 SPRAYED MINERAL FIRE PROTECTION

51.1 GENERAL

51.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows: Insulation and barriers.
Metals and Prefinishes.
Heavy Duty Galvanised Coatings.
>

51.1.2 GENERAL STANDARDS

Sprayed mineral fire protection

To provide the required period of fire resistance and be included in the FSSB product listings.

Materials and components: >

Execution: >

51.1.3 DESIGN

Drawings

Contract drawings show generic design principles and design intent only.

51.2 QUALITY

51.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of the following:

- Substrate preparation completed.
- Coating support installed.

Hold points

- Those parts of the sprayed mineral fire protection installation which will be covered up or concealed.

>

Corrosion

Cross refer: General Requirements Clause 20.4.1.

51.2.2 TESTS

General

Carry out all tests in accordance with Section 20.3.2 'Tests' of the General Requirements.

Materials

To BS 476: Part 20.

51.2.3 SAMPLES

General

Submit samples in accordance with Section 20.3.4 'Samples', of the General Requirements.

Submit samples of each specified coating at the required thickness, density, colour, texture and support type.

Size: 600 mm square.

No of samples: 3.

51.2.4 PROTOTYPES

General

Construct all prototypes in accordance with the requirements of Section 20.3.5, 'Prototypes' of the General Requirements.

Confirmation Prototype

Provide a confirmation prototype of all fire stopping installations.

Location: As agreed with the Engineer.

Incorporating: Perimeter details as directed by the Engineer.

Retain all prototypes until the completion of the works or as directed by the Engineer.

Incorporate accepted prototypes into the work as directed by the Engineer.

51.2.5 SUBMISSIONS

General

Make all submissions in accordance with the requirements of Section 20.3.6, 'Submissions' of the General Requirements.

Subcontractor

Submit name and contact details of proposed suppliers and specialist installer(s).

Substrate

Cleaning: Give notice of surface conditions which cannot be corrected by normal cleaning methods.

Engineering endorsement

Cross refer 'General Requirements' Section 20.3.7 'Submissions'.

Shop drawings

General: Submit shop drawings in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Submit shop drawings showing, but not limited to, the following information:

- General arrangements of sprayed fire insulation identifying panel numbers and differing performance requirements.
- All brackets, supports, fixings and accessories.
- Frame and support details.
- Interfacing details.

No of copies to be submitted: As Particular Specification.

Manufacturers' information

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with Section 20.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No of copies to be submitted: 3.

Test Reports

Submit copies of current test reports, and certification, including drawings of tested details, for each specified or proposed sprayed mineral fire protection system in accordance with Section 20.3.2, 'Tests' of the General Requirements.

Submit PSB test reports.

No of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with Section 20.3.6 'Submissions' of the General Requirements.

51.3 MATERIALS AND COMPONENTS

51.3.1 MATERIALS

General

Shelf life: Ensure materials used have not exceeded their shelf life.

Toxic materials: Use materials which are certified free of asbestos and lead, or any other known toxin, and free of, nor requiring the use of, toxic solvents.

Do not use materials which contain known carcinogenics.

Corrosivity: Non-corrosive.

Do not use intumescent materials or rely on intumescent coatings internally.

Confirm that materials used in conjunction are compatible with one another, the substrates on which they are used, and all adjacent materials in the completed building.

Base

General: Either perlite or vermiculite.

Standard: To BS 3797.

Binding agent

Gypsum plaster: To AS 2592.

Fillers

Either hydrated lime or limestone.

Decorative and protective surface finishes >

51.3.2 COMPONENTS

Metal components

Either galvanized steel or stainless steel.

Expanded metal lath

- Either galvanized steel or stainless steel.
- Aperture: 10 - 20 mm.

Furring channels

Either galvanized steel or stainless steel.

Self-furring expanded metal lath

- Either galvanized steel or stainless steel.
- Aperture: 10 - 20 mm.
- Ribs: V-shaped at 100 - 150 mm intervals.

Steel wire mesh

Either galvanized steel or stainless steel.

Welded rectangular mesh:

- Keying: Aperture 10 - 25 mm, wire diameter 0.7 - 1.6 mm.

Twisted hexagonal mesh: To AS 2423.

- Keying: Aperture 10 - 25 mm.

51.4 EXECUTION

51.4.1 EXECUTION GENERALLY

Applicators

Must be licensed by the coating manufacturer to install the coating.

Surface preparation

Establish nature of all coatings on the surface to take the sprayed mineral fire protection; check for compatibility and confirm the same to the Engineer.

Sprayed to contour: Immediately before applying the protection, remove materials which will impair adhesion to the substrate, including mill scale, dirt, grime, oil, grease, dust, loose rust, non-compatible primers and paint.

- Primer: As required by the protection manufacturer.

Sprayed on metal lath: If paint on the steel sections is not compatible with the spray, apply an alkali-resistant sealer which is compatible with the paint.

Stable gaps and joints wider than 15 mm: Bridge with an appropriate supporting material before applying the spray.

Unstable gaps and joints: Provide a movement joint in the spray, with metal lath support on either side of the joint.

Protection of areas not to be coated

Prevent damage from spillage, overspray, contamination and fallout.

Sequence

Apply coatings after installation of supports, fixings and other attachments, but before installation of items which may obstruct the application.

Sprayed to contour

Reinforcement: Steel wire mesh to AS 3748.

- Welded mesh.
- Twisted mesh.

Sprayed on expanded metal lath

Walls:

- Support: To AS3784.1 Table 1.

Columns:

- Support: To AS3784.1 Table 1.

Beams:

- Support: To AS3784.1 Table 1.

Fixing reinforcement and support

Flat substrates: >

- Fastening reinforcement to fixing: >

Encapsulated substrates - no support needed: Wrap and overlap reinforcement at joints and wire tie together.

Encapsulated substrates - additional support needed:

Sprayed fire protection coatings thickness schedule

Application type	Sprayed fire protection coating designation		
	SFPC1	SFPC2	SFPC3
Sprayed to contour (minimum) (mm)	>	>	>
Sprayed on metal lath (minimum) (mm)	>	>	>

Number of coats

Coating ≤ 25 mm: >

Density

Density of dry coating: >

Spraying

Provide good cohesion in the coating.

External coatings

During setting: Prevent exposure to rapid drying, wind-driven rain, running water, structural movement, vibration or impact.

Detailing: Provide weather-seal at the coating-substrate interface with mastic sealant or weather shields.

Finishes

Colour: >

Texture: >

Fungicide: >

- Application: >

51.5 COMPLETION

51.5.1 COMPLETION TESTS

General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Thickness measurements

Criteria: Either

- thickness ≥ 85% specified thickness, deficient area ≤ 1 m², and no other deficient area within 3 m of this deficient area; or
- thickness ≥ 75% specified thickness, deficient area ≤ 0.2 m², and no other deficient area within 1 m of this deficient area.

Thickness gauge: Where possible, use a reliable direct-reading pin-type thickness gauge with a base plate of 25 mm diameter, of the sort shown in AS 3784.1 Figure 5. Otherwise use prefixed gauges which will not impair fire performance.

Frequency of measurement:

- Flat substrates: 4 measurements for an area of 3 x 3 m, and 1 measurement for each additional area of 3 x 3 m. Take measurements where thickness is likely to be low.

- Contoured substrates: As for flat substrates. For trapezoidal shapes take random measurements at changes in plane. For I columns and beams, take ≥ 1 measurement per 3 m on each surface. Check thickness across the flange and over the flange edges if the coating appears to taper on the flanges.
- Substrates overlaid with expanded metal lath or steel wire mesh: As for flat and contoured substrates. Measure thickness to the face of the overlay.

Dry density measurement

Criteria: Manufacturer's stated average dry density $\pm 15\%$.

Tools:

- Rule: Steel, accuracy of 1 mm.
- Balance: Accuracy $\geq 1\%$.
- Template: Known area $\geq 0.1 \text{ m}^2$, sides $\geq 150 \text{ mm}$.

Method: Using the template, mark off the known area on a sample. Measure thickness of the sample at ≥ 10 points using the thickness gauge. Cut out the complete marked-off sample and dry at 50°C until constant mass is achieved. Determine the mass (kg) and calculate the dry density (kg/m^3).

Frequency of measurement: >

51.5.2 COMPLETION SUBMISSIONS

Operation and Maintenance Manual

On completion submit an Operation and Maintenance Manual in accordance with Item 20.5.3 'Operation and Maintenance Manuals' of the General Requirements.

Include:

- A completed certification document endorsed by the manufacturer confirming that the sprayed mineral fire protection had been correctly installed and are in compliance with this specification.
- **A schedule of installed sprayed mineral fire protection identifying the location of each and period of fire resistance.**

Test results

Submit results of thickness and density measurements.

Cleaning

Remove spilled and excess fire protection materials without damaging other work.

Protection

Protect all fire protection on site from damage until handover.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

On or before completion of the works remove all materials used as a means of protection.

Warranties

Warrant the materials and workmanship as part of the overall assembly in which the fire protection is employed using the Authority's standard warranty form for the period(s) stated in Item 20.5.1 'Warranties' of the General Requirements.

Record drawings

Provide record drawings in accordance with Item 20.5.2, Record Drawings, of the General Requirements.

51.5.3 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

60 METALS AND PREFINISHES

60.1 GENERAL

60.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows: Heavy Duty Galvanized Coatings.
Painting.

60.1.2 EQUIPOTENTIAL BONDING REQUIREMENTS (EPB)

Cross Refer: Section 20.2.7 'Design' of the General Requirements.

60.1.3 TOUCH VOLTAGE PROTECTION

Cross Refer: Section 20.2.7 'Design' of the General Requirements.

60.1.4 INTERPRETATION

Authority's Sample: A sample held by the Authority and available for viewing during the tender and construction periods.

60.2 QUALITY

60.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of :-

- All pre-finished materials prior to the application of finishes.
- All pre-finished materials prior to their delivery to the works.

Corrosion

Cross refer: General Requirements Clause 20.4.1.

60.2.2 TESTS

General

Carry out all tests in accordance with Section 20.3.2, 'Tests' of the General Requirements.

Ferrous Metals

- 1,000 hour intermittent salt spray test to ASTM B117-02. Pass criteria, no visible changes.

60.2.3 SAMPLES

General

Submit samples of each of the following in accordance with Section 20.3.4 'Samples', of the General Requirements:

- Each type of metal, finished as intended for use in the works.
- Each type of metal joint proposed for use in the works.

Size of samples:

- Area samples 300mm sq.
- Linear samples : minimum 600mm.

No of samples: 3.

60.2.4 SUBMISSIONS

General

Make all submissions in accordance with the requirements of Section 20.3.6, 'Submissions' of the General Requirements.

Subcontractors

Submit names and contact details of proposed manufacturers and installers.

Shop drawings

General: Submit shop drawings in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Shop drawings shall show, but not limited to, the following information:

- Component drawings of all metalwork.
- A numbering system enabling all items to be identified.
- Details of all required joints and interfaces.
- Touch voltage electrical insulation and EPB provisions.
- Method of assembly.

No. of copies to be submitted: As Particular Specification.

Engineering endorsement

Submit calculations and drawings from a Singapore licensed Professional Engineer concurrently with the shop drawings and showing, but not limited to, the following:-

compliance with all relevant Singapore legislation and regulations.

Manufacturers' information

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No of copies to be submitted: 3.

Test Reports

Submit copies of current test reports, and certification in accordance with Section 20.3.2, 'Tests' of the General Requirements.

Submit PSB test reports.

No of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with Section 20.3.6 'Submissions' of the General Requirements.

60.3 MATERIALS AND COMPONENTS

60.3.1 METALS

Steel

Hollow section: To AS 1163.

Bars and sections: To AS/NZS 3679.1.

Sheet: To AS/NZS 1595.

Steel for prefinishes

Electric resistance welded pipe: To AS 1450 "bright".

Cold rolled bar: To AS 1443 "bright".

Cold rolled sheet: To AS 1595.

- Designation: CA2S-E.

Coated steel

Metallic coated sheet: To AS 1397.

Thickness: Metal thicknesses specified are base metal thicknesses.

Ferrous hollow sections by electrogalvanizing: To AS 4750 (Int).

- Minimum coating class: ZE300/300.

Ferrous hollow sections by a continuous or specialised process: To AS/NZS 4792.

- Minimum coating class: HDG300.

Ferrous open sections by electrogalvanizing: To AS 4751 (Int).

- Minimum coating class: ZE300.

Ferrous open sections by an in-line process: To AS/NZS 4791.

- Minimum coating class: ILG200.

Steel wire: To AS/NZS 4534.

- Minimum coating class: W10Z.

Stainless steel

Plate, sheet and strip: To ASTM A240/A240M.

Bars: To ASTM A276.

Welded pipe (round): To AS 1769.

Welded pipe (square): To ASTM A554.

Type: Austenitic.

Grade: 316.

304 (internal use only).

Cast stainless steel

Method: Investment or lost wax casting.

Grade: 316.

Aluminium and aluminium alloys

Drawn rod, bar and strip: To AS/NZS 1865.

Extrusions: To AS/NZS 1866.

Drawn pipe: To AS/NZS 1867.

Plate and sheets: To AS/NZS 1734.

Titanium zinc

Electrolytic high-grade zinc to EN 1179 (European norm), 99.995 % zinc purity, with copper and titanium alloying additives.

Thickness: as specified in work sections.

Copper and copper alloys

Casting: To AS 1565.

Plate, sheet and strip: To AS 1566.

Rods, bars and sections: To AS/NZS 1567.

60.4 METAL FINISHING

60.4.1 WORKMANSHIP

Preparation

General: Before applying decorative or protective prefinishes to metal components, complete welding, cutting, drilling and other fabrication, and prepare the surface using a method accepted by the Engineer.

Standard: To AS 1627.

Priming steel surfaces: Where site painting is specified to otherwise uncoated mild steel or similar surfaces:-

- prime after fabrication and before delivery to the works; and,
- after installation, repair damaged priming to match the standard of undamaged areas and complete the coverage to unprimed surfaces.

Welding

Steel: To AS/NZS 1554.1.

Aluminium: To AS 1665.

Stainless steel: To AS/NZS 1554.6.

Site welding: Will not be accepted unless identified beforehand and authorised by the Engineer.

Brazing

General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. For butt joints do not rely on the filler metal fillet only.

Filler metal: To AS 1167.1.

Finishing

Visible joints: Finish visible joints made by welding, brazing or soldering using methods appropriate to the class of work (including grinding or buffing) before further treatment such as painting, galvanizing or electroplating. Ensure self-finished metals are without surface colour or textural variations after jointing.

Damage

If prefinishes are damaged, including damage caused by unauthorised site cutting or drilling, remove and replace the damaged item.

Cutting

Do not cut or grind metals in the vicinity of stainless steel.

60.4.2 SELF FINISHING

Mechanical finishes

Bright finished copper alloy surfaces: For indoor applications, apply a clear lacquer protecting coating.

Self finishes schedule

System	SF1	SF2	SF3
Item	Stainless steel	>	>
Surface	Exposed	>	>
Finish	No 4 continuous hairline polished using a 180 –240 grit size.	>	>

60.4.3 ELECTROPLATING

Electroplated coatings

Zinc on iron or steel: To AS 1789.

Chromium on metals: To AS 1192.

Nickel on metals: To AS 1192.

Service condition number: At least 2.

Zinc plating schedule

System	ZP1	ZP2	ZP3
Item to be coated	>	>	>
Service condition number	>	>	>
Chromate conversion coating type	>	>	>
Finish	>	>	>

Chromium plating schedule

System	CP1	CP2	CP3
Item to be plated	>	>	>
Service condition number	>	>	>
Finish	>	>	>

60.4.4 ANODISING

Anodising

Standard: To AS 1231.

Thickness grade:

- Indoor applications: At least AA10.
- Outdoor applications: At least AA25.

Anodising schedule

System	AA1	AA2	AA3
Item to be anodised	>	>	>
Surface texture and finish	>	>	>
Colour	>	>	>
Thickness grade	>	>	>
Tests	>	>	>

60.4.5 METAL SPRAYING

Metal spray

Standard:

- To ISO 2063.

Process: Electric arc.

Minimum thicknesses:

- Outdoor applications: 175 µm.
- Indoor applications: 125 µm.

Seal coat: Cover the metal spray finish with two coats of vinyl seal to a total dry film thickness of 80 µm.

Metal spray schedule

System	MS1	MS2	MS3
Items to be sprayed	>	>	>
Abrasive blast cleaning to AS 1627.4	>	>	>
Metal spray type	>	>	>
Seal coat	>	>	>

60.4.6 POWDER COATING

Thermoset powder coating

Standards:

- To AS 3715.
- To AS/NZS 4506.

Internal use: APAS-0155/1.

External use: APAS-0155/2.

Finish: Full gloss.

Preparation

General:

- Use chemical pre-treatments.
- If recommended by the coating manufacturer, provide conversion coatings.

Unprotected steel: Remove rust to the recommendations of AS 1627.4 to grade Sa 2½ of AS 1627.9. Clean by immersing in trichloroethylene or an alkaline solution, and apply a coat of iron phosphate.

Galvanized steel: Clean by immersing in a suitable alkaline or acidic solution, apply a zinc phosphate chemical conversion coating, rinse and degrease.

Aluminium: Pretreat to AS 3715 Appendix G.

Thermoset powder coating schedule

System	PC1	PC2	PC3
Item to be coated	>	>	>
Colour	>	>	>
Type of coating	>	>	>
Number of coats	>	>	>
Coating thickness	>	>	>

60.4.7 PREPAINTING

Prepainted metal products

Standard: To AS/NZS 2728.

Product type: Not lower than the type appropriate to the field of application.

Product finish: >

High performance organic coatings

Type: Factory applied spray coatings on aluminium products, including polyvinylidene fluoride (PVF₂) coatings.

Standards: To AAMA 2604 and AS 2728.

High performance organic coatings schedule

System	OC1	OC2	OC3
Item to be coated	>	>	>
Coating material	>	>	>
Number of coats	>	>	>
Coating thickness	>	>	>

Equipment paint system

General: Brush, roller or spray application, as recommended by the paint manufacturer, using paint as follows:

- Prime coat to metal surfaces generally: APAS-0032 or APAS-0162/1.
- Lead and chromate-free primer for iron and steel substrate: to SS 494
- Prime coat to zinc-coated steel: APAS-0017 or APAS-0134.
- Undercoat: APAS-0029.
- Full gloss enamel finish coats, oil and petrol resistant: APAS-0024/1, two coats.
- Aluminium paint: to SS 37

Do not spray paint in underground locations.

Two-pack liquid coating

Primer: Two pack epoxy primer to APAS-2971.

Topcoat:

- Internal use: Proprietary polyurethane or epoxy acrylic system.
- External use: Proprietary polyurethane system.

Application: Spray.

Finish: Full gloss.

Epoxy Polysiloxane

Two coat primer free system.

Application: Spray.

Finish: Gloss.

Micaceous Iron Oxide

>

>

>

Air-drying enamel

Internal use:

- Primer: Two-pack epoxy primer to APAS-2971.
- Topcoats: 2 coats to APAS-0015/1.

Application: Spray or brush.

Finish: Full gloss.

Stoving enamel

Internal use:

- Primer: To APAS-0065.
- Topcoat: To APAS-0066/3.

Application: Spray or dip.

60.4.8 COMPLETION

General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Protection

Protect all metal items on site from damage until handover.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

On or before completion of the works remove all materials used as a means of protection.

Damage

Replace damaged items with new.

Warranties

Warrant the materials and workmanship as part of the overall assembly in which the metal and/or prefinish is employed using the Authority's standard warranty form for the period(s) stated in Item 20.5.1 'Warranties' of the General Requirements.

60.4.9 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

70 HEAVY DUTY GALVANIZED COATINGS
--

70.1 GENERAL

70.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows: Metals and Prefinishes.

70.2 QUALITY

Provide samples in accordance with AS/NZS 4680 clause 7, note 2, to determine acceptable defects/quality of finish.

70.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of the following:

- All materials immediately prior to the application of zinc.
- Coating integrity, at the galvanizing plant.

Hold points

- Completion of all remedial work to galvanizing on site.

Corrosion

Cross refer: General Requirements Clause 20.4.1.

70.2.2 TESTS

General

Carry out all tests in accordance with Section 20.3.2, 'Tests' of the General Requirements.

Testing venue

General:

- Galvanizing plant.
- Accredited testing laboratory.

Galvanizing tests

Sampling plan: In accordance with the recommendations of Appendix B to AS 1214 or Appendix B to AS/NZS 4680, as appropriate.

Coating mass tests: Required.

Coating thickness tests: Required.

Coating uniformity tests: Required.

Frequency of tests: To AS/NZS 4680 clause A2(k).

70.2.3 SUBMISSIONS

General

Submit in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Subcontractor

Submit name and contact details of proposed specialist galvanizing subcontractor(s).

Galvanizing tests

Coating mass and adhesion: Submit a test report.

Problematic design

- Submit advice on design and fabrication features of the articles to be galvanized which may lead to difficulties during galvanizing. Submit advice prior to the start of galvanizing and in sufficient time to allow amendments to be made to the design.
- Submit advice on the probability of distortion during the galvanising process.

Holes and lifting lugs

Submit advice on size and locations of holes and lifting lugs to facilitate handling, filling, venting and draining during galvanizing.

Removal of deleterious materials

Submit advice on suitability of marking paints, and removal of materials deleterious to galvanizing such as grease, oil and paint.

Method Statement

General: Submit method statements in accordance with Section 20.3.6 'Submissions' of the General Requirements.

70.3 FABRICATION

70.3.1 GALVANIZING GENERALLY

Hot-dip galvanized coatings

Ferrous articles: To SS 117.

Threaded fasteners: To AS 1214.

Care

Mechanical properties: Avoid mechanical damage. Ensure that mechanical properties of the base metal do not change.

Dimensional change: Avoid.

Embrittlement: Take due care in processing steel that is susceptible to embrittlement.

Drilling

Provide holes required for filling venting or draining etc. to AS/NZS 4680 Clause 4.

Drilling and oxy-cutting by the galvanizer is not acceptable.

Surface preparation

Surface contaminants and coatings generally: Chemical clean, then acid pickle.

Surface contaminants and coatings which cannot be removed using chemical cleaning: Abrasive blast clean.

Chemical cleaning: To AS 1627.1.

- Cleaning designation: AD.

Acid pickling: To AS 1627.5.

- Acid: Hydrochloric.
- Inhibitor: to AS/1627.5 clause 2.3.2.

Abrasive blast cleaning: To AS 1627.4.

- Grade: Sa 2~~1/2~~ to AS 1627.9.
- Abrasive: To AS 1627.4 table 1.

Surface finish

Coating quality: Continuous, adherent, smooth or evenly textured and uniform, free from defects detrimental to the end use of the finished article, such as lumps, blisters, gritty areas, uncoated spots, acids and black spots, dross and flux.

- Silicon killed steels: Dull grey is acceptable.

Friction-type bolted connections: Treat contact surfaces to achieve the required slip factor.

- Method: Wire brushing or light grit blasting.
- Finish for contact surfaces: galvanizing.
- Slip factor tests: required to AS 4100 Appendix J.

Surplus zinc on fastener threads: Remove.

Coating reinstatement

Method: Wire brush or mechanically buff the surface. Apply zinc-rich primer to 150µm dry film thickness. Stipple edges of the primed area.

- Surface preparation: To AS 1627.2 and grade St 2 to AS 1627.9.
- Primer: To APAS-0014/1 or APAS-2916.

Extent: Significant areas of uncoated surface, and areas damaged by handling at the galvanizing plant.

- Size of area to be repaired: Relevant to the size of the article and the conditions of service. All repairs visible on the completed work to be masked off and to end on straight lines.

70 HEAVY DUTY GALVANIZED COATINGS

Structural sections

Cold worked items: Except for hollow sections, anneal to 650°C before galvanizing.

Coating mass: Other than nut and bolt thread surfaces:

- Minimum average: 600 g/m².

Hollow sections: Provide seal plates with breather holes.

Components in contact with concrete

General: Chromate passivate.

Chromate passivation process: Dip in 0.15 - 0.2% sodium dichromate solution.

Preparation for architectural finishes

Coarse preparation: Remove spikes, and ensure edges are free from lumps and runs.

Light sweep blasting:

- Blast pressure (maximum): 280 kPa.
- Abrasive grade (range): 0.2 - 0.5 mm clean ilmenite or garnet.
- Angle of blasting to surface: 45.
- Distance of nozzle from surface (range): 300 – 400 mm.
- Nozzle type: Venturi, diameter 10 – 13 mm.

Galvanizing schedule

Article	End use	Friction-type bolting slip factors	Conditions of service	Coating mass
>	>	>	>	>
>	>	>	>	>
>	>	>	>	>

Storage of galvanized articles

General: Store in dry, well ventilated conditions. Store in a manner which will prevent the formation of 'white rust' or other wet storage stains. Galvanizing showing white rust or wet storage stains will be rejected.

70.4 EXECUTION

70.4.1 ERECTION GENERALLY

Delivery

Transport in dry, well ventilated conditions.

Welding

Welding of galvanized steel will not be accepted unless identified beforehand and authorised by the Engineer.

Grinding of edges: Permitted.

Weld areas: Reinstate coating.

Site coating reinstatement

Method: Wire brush or mechanically buff the surface. Apply zinc-rich primer to 150 µm dry film thickness. Stipple edges of the primed area.

- Surface preparation: To AS 1627.2, and grade 2½ to AS 1627.9.
- Paint standard: To APAS-0014/1 or APAS-2916.

Extent: Areas damaged by transport, site welding, site flame cutting, site handling, or erection.

- Size of area to be repaired: Relevant to the size of the article and the conditions of service. All repairs visible on the completed work to be masked off and to end on straight lines.

Architectural finishes schedule

Article	Architectural finish	Specification cross reference
>	>	>
>	>	>
>	>	>

70.5 COMPLETION

70.5.1 COMPLETION SUBMISSIONS

Certificate

Submit a certificate from the galvanizer stating that the galvanizing conforms to this specification.

Protection

Protect all galvanising from damage until handover.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

On or before completion of the works remove all materials used as a means of protection.

Warranties

Warrant the materials and workmanship as part of the overall assembly in which galvanising is employed using the Authority's standard warranty form for the period(s) stated in Item 20.5.1 'Warranties' of the General Requirements.

90 CONCRETE FINISHES

90.1 GENERAL

90.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows:

Civil and Structural M & W Specification, Section(s) >
Adhesives Sealants and Fastenings.

>

90.1.2 INTERPRETATION

Authority's Sample: A sample held by the Authority and available for viewing during the tender and construction periods.

90.2 QUALITY

90.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of :

- Completion of all sample panels.
- Construction of formwork.
- Pre cast panels at the factory prior to their delivery to site.

Hold points

- Completion of formwork.
- Completion of confirmation prototypes.

90.2.2 SAMPLES

General

Submit samples of each of the following in accordance with Section 20.3.4 'Samples', of the General Requirements.

- Sealants.
- Cast-in fixings.
- Exposed aggregates.

No of samples: 3.

Submit 600mm square samples of the proposed finish to allow the acceptable number of blowholes and the expected tonal range to be agreed with the Engineer.

No of samples: 6.

Prototypes

Construct all prototypes in accordance with the requirements of Section 20.3.5, 'Prototypes' of the General Requirements.

Confirmation Prototype

Provide confirmation prototypes of all concrete finishes.

Location: As agreed with the Engineer.

Minimum size

- Panel 2.0 x 2.0m.
- Column Full height.
3.0m.

- Pre-cast item Full size panel.

- Incorporating
- Horizontal and vertical.
Formwork joints.
 - Penetrations.
 - Internal corner detail.
 - Edge details as directed by the Engineer.

Seal 50% of the prototype area using the proposed sealant.

Retain all confirmation prototypes until the completion of the works or as directed by the Engineer.

Incorporate accepted prototypes into the work as directed by the Engineer.

Prototype panels

Do not proceed with the concreting work until the range of surface finishes and treatments has been accepted by the Engineer.

90.2.3 SUBMISSIONS

General

Make all submissions in accordance with the requirements of Section 20.3.6, 'Submissions' of the General Requirements.

Subcontractors

Submit name and contact details of proposed specialist concreting subcontractor(s).

Shop Drawings

Submit shop drawings showing, but not limited to, the following information:

- Formwork layout.
- Location of all cast-in components.
- Edge and interfacing details.
- Movement joints.

No. of copies to be submitted: As Particular Specification.

Formwork

Submit details of all proposed formwork, including, but not limited to, proposals for the re-use of formwork.

Protection

Submit details of all protection to be given to the finished concrete prior to handover.

Surface Repair

Submit proposed methods for repair of damaged on site concrete finishes rejected by the Engineer.

Manufacturers' information

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with Section 20.3.6 'Submissions' of the General Requirements.

Notice

Give notice if substrates are not suitable for sealants.

90.3 MATERIALS AND COMPONENTS

90.3.1 HAZARDOUS MATERIALS

General

- Ensure materials are free of, or do not require the use of, toxic solvents.
- Do not use materials which contain known carcinogenics.

90.3.2 MATERIALS

Concrete

To SS 289.

Precast concrete Slab and Wall panels

To SS CP 81.

Fluro-Silicate Sealers

Type: penetrating, non staining.

Surface hardeners

Type: non-metallic.

Abrasion resistance. To ASTM C779-74.

Hardness: 9 mohs minimum.

Adhesion: 4.5. kg/sq.cm. minimum.

Chemical resistance of at least 4 to 6 times greater than untreated surface.

Formwork

General: To AS 3610.

90.4 EXECUTION

90.4.1 TOLERANCES

Tolerance classes

Determine tolerance classes using a straight edge placed anywhere on the surface in any direction.

Sudden changes in the line of the finished concrete will not be acceptable.

Tolerances class table

Class	Measurement	Maximum deviation (mm)
A	3 m straight edge	3
B	3 m straight edge	6

90.4.2 SURFACE MODIFIERS

Surface hardeners

Apply to clean surfaces. Do not apply to non-slip topping.

90.4.3 UNFORMED SURFACES

Screeding

Strike off, consolidate and level slab surfaces to finished levels, to tolerance class A.

Finishing methods

Machine floated finish: After screeding consolidate the surface using a machine float. Hand float in locations inaccessible to the machine float. Cut and fill to tolerance class B and refloat immediately to a uniform, smooth, granular texture.

Steel trowelled finish: After machine floating, use power trowels to produce a smooth surface relatively free from defects. Then, when the surface has hardened sufficiently, use steel hand trowels to produce the final consolidated finish free of trowel marks and uniform in texture and appearance, to tolerance class A. Where floor coverings are to be installed, remove defects that would show through them.

Wood float finish: Produce the final finish using a wood float.

90.4.4 FORMED SURFACES

Evaluation of formed surfaces

If evaluation of formed surface tolerance or colour is required, complete the evaluation before surface treatment.

Surface finish class F3-a

Must have the characteristics of Class 'F3' (as specified in Clause > of the Materials and Workmanship Specification for Civil and Structural Works) plus the following:-

Uniform quality and texture over the entire area.

Blowholes must be within the numerical and size range agreed with the Engineer on the acceptance of submitted samples.

A tonal range agreed with the Engineer on the acceptance of submitted samples.

Edges, corners and joints as agreed with the Engineer on the acceptance of the prototypes.

Surface Finish Class F3-b

Must have the characteristics of Class 'F3-a' but use new form linings and facings for each new pour.

Surface Finish Class F4-a

Must have the surface finish of Class 'F3-a' and the characteristics of Class F4 (as specified in Clause > of the Materials and Workmanship Specification for Civil and Structural Works).

Smooth rubbed finish

Remove the forms while the concrete is green, patch immediately, and complete the rubbing not later than the following day. Wet the surface and rub using a carborundum or similar abrasive brick until a uniform colour and texture are produced. Do not provide cement grout other than the paste drawn from the green concrete by the rubbing process.

Exposed aggregate finish

Remove the forms while the concrete is green. Wet the surface and scrub using stiff fibre or wire brushes, using water freely, until the surface film of mortar is mechanically removed without the use of acid etching, and the aggregate uniformly exposed. Rinse the surface with clean water.

Bush hammered finish

Remove the minimum matrix using bush hammering to expose the coarse aggregate without recessing the matrix deeper than the aggregate, to give a uniform texture with insignificant random tool marks.

Floated finishes

Sand floated finish: Remove the forms while the concrete is green. Wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.

Grout floated finish: Remove the forms while the concrete is green. Dampen the surface and spread, using hessian pads or sponge rubber floats, a slurry consisting of one part cement (including an appropriate percentage of white cement) and one and a half parts sand passing a 1 mm sieve. Remove surplus until a uniform colour and texture are produced. Cure.

Blasted finishes

Abrasive: Blast the cured surface using hard, sharp graded abrasive fine aggregate particles until the coarse aggregate is in uniform relief.

Light abrasive: Blast the cured surface using hard, sharp graded abrasive fine aggregate particles to provide a uniform matt finish without exposing the coarse aggregate.

90.4.5 SURFACE REPAIR

Repair surface finishes only on receipt of the Engineers written acceptance of the proposed repair method.

Comply with all repair conditions required by the Engineer.

90.4.6 SCHEDULE

Integral finishes schedule

Finish type	FT1	FT2	FT3
Location	>	>	>
Tolerance class	>	>	>
Integral finish	>	>	>
Final finish	>	>	>
Non-slip finish	>	>	>
Surface modifier	>	>	>

90.4.7 COMPLETION

General

Cross refer: Item 20.5 ‘Completion’ of the General Requirements.

Protection

Protect all completed concrete on site from damage until handover.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

On or before completion of the works remove all materials used as a means of protection.

Warranties

Warrant the materials and workmanship as part of the overall assembly in which the concrete is employed using the Authority’s standard warranty form for the period(s) stated in Item 20.5.1 ‘Warranties’ of the General Requirements.

90.4.8 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

100 BRICK AND BLOCK CONSTRUCTION

100.1 GENERAL

100.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows: Metals and Prefinishes.

Heavy Duty Galvanised Coatings.

>

100.1.2 CIVIL DEFENCE (CD) REQUIREMENTS

General

Where stations are identified as having Civil Defence (CD) requirements, refer the CD Design Criteria for requirements and information relating to the upgrading of fixing methods for CD stations.

100.1.3 STANDARD

General

Materials and construction: To AS 3700.

Where required in the contract, the contractor may be asked to take responsibility for the design elements within AS 3700.

100.1.4 INTERPRETATION

Definitions

Bedding:

- Face shell: Covering the parts of a hollow unit which are connected by webs, but not the webs themselves with mortar.
- Full: Covering the entire plan area of a solid unit with mortar.

Brickwork and blockwork types:

- Prestressed: Brickwork and blockwork in which some or all cavities or cores are reinforced with stressed tendons.
- Reinforced: Brickwork and blockwork in which some or all grouted cavities or cores are reinforced with steel reinforcement.
- Special: Brickwork and blockwork with specified strength values higher than those specified in AS 3700 and which is tested during its construction to verify that those values have been achieved.
- Standard: Brickwork and blockwork which is not tested for specified strength values.

Compressive strength:

- Bricks or blocks: The characteristic unconfined compressive strength when tested in accordance with AS/NZS 4456.4.
- Brickwork or blockwork: The characteristic unconfined compressive strength determined in accordance with AS 3700.

Face units: Bricks or blocks used in facework, including purpose-made units such as squints, sills and thresholds.

Facework: Brickwork or blockwork in which the form, or form and colour, of the face units and joints is visible in the completed works.

Joint:

- Bed joint: Joint formed by the mortar on which the bricks and blocks are laid.
- Control joint: Joint constructed in brickwork or blockwork to control and absorb movements in it.
- Flush joint: Joint that is finished flush with the surface of the bricks or blocks.
- Perpend: Joint formed between adjacent bricks or blocks laid in the same course.
- Raked joint: Joint that is raked out to a specified depth behind the face of the bricks or blocks.
- Tooled joint: A joint, including flush joint and raked joint, in which the surface is trowelled or ironed to a smooth, dense finish.

Ties:

- Cavity tie: Tie connecting two leaves of masonry that are separated by a cavity of any width.

- Head and column tie: Tie connecting masonry to a structural support.
- Type A tie: Tie not required to have specific seismic design characteristics.
- Type B tie: Tie required to have specific seismic design characteristics.
- Veneer tie: Tie connecting a masonry veneer to a frame or wall designed to resist lateral forces.

Authority's Sample: A sample held by the Authority and available for viewing during the tender and construction periods.

100.1.5 DESIGN

Drawings

Contract drawings show generic design principles and design intent only.

100.2 QUALITY

100.2.1 INSPECTION

Witness points

Stages: Give sufficient notice so that inspection may be made of the following:

- Damp-proof courses, in position.
- Flashings, in position.
- Bottoms of cavities, after cleaning out.
- Bottoms of core holes, before grouting.
- Control and movement joints ready for insertion of joint filler.
- Lintels, in position.
- Structural steelwork, including bolts and shelf angles, in position.

Hold points

Completion of all confirmation prototype panels.

Corrosion

Cross refer: General Requirements Clause 20.4.1.

100.2.2 TESTS

General

Carry out all tests in accordance with Section 20.3.2 'Tests' of the General Requirements.

Masonry units test criteria

General: The criterion for the relevant test stated or recommended in AS/NZS 4455, or the specified criterion (in which case the latter prevails).

Masonry units tests schedule

Attribute	Test method	Number of tests
Potential to effloresce	AS/NZS 4456.6	>
Care % and material thickness	AS/NZS 4456.7	>
Moisture content and dry density	AS/NZS 4456.8	>
Resistance to salt attack	AS/NZS 4456.10	>
Coefficients of expansion	AS/NZS 4456.11	>
Coefficient of contraction	AS/NZS 4456.12	>
Pitting due to lime particles	AS/NZS 4456.13	>
Water absorption properties	AS/NZS 4456.14	>
Lateral modulus of rupture	AS/NZS 4456.15	>
Permeability to water	AS/NZS 4456.16	>
Initial rate of absorption	AS/NZS 4456.17	>
Tensile strength	AS/NZS 4456.18	>

Mortar chemical tests

Test Criterion >

Number of tests: >

Special masonry tests

Areas of special masonry for testing to be identified on the drawings.

>

Special masonry tests schedule

Property to be tested	Test criterion	Number of tests
Compressive strength	AS 3700 Appendix C	>
Flexural strength	AS 3700 Appendix D	>

Sand and aggregates

To SS73.

100.2.3 SAMPLES

General

Submit samples of each of the following in accordance with Section 20.3.4 'Samples', of the General Requirements.

No. of samples: 3.

Masonry unit samples

General: Submit face units of each type illustrating the range of variation available, including colour, texture, surface irregularities, defective arrises, and shape.

Sand samples

General: Submit a 2 kg sample of each type of sand required to be of a particular colour, grade or source.

Accessories

Submit samples of each accessory proposed for fixing brick and blockwork.

100.2.4 PROTOTYPES

General

Construct all prototypes in accordance with the requirements of Section 20.3.5, 'Prototypes' of the General Requirements.

Confirmation Prototype

Provide a confirmation prototype of all type of facework including face or pointing mortar

Location: As agreed with the Engineer.

Minimum size (face of panel) (mm): Panel height x 3.0m length.

Incorporating

- Door opening.
- Service outlets as identified by the Engineer.
- Corner.

Footings: >

Retain all prototype panels until the completion of the works or as directed by the Engineer.

Incorporate accepted prototypes into the work as directed by the Engineer.

Facework set-out

General: Provide a dry laid trial set-out of 2 courses for each panel of facework.

100.2.5 SUBMISSIONS

General

Make all submissions in accordance with the requirements of Section 20.3.6, 'Submissions' of the General Requirements.

Subcontractor

Submit name and contact details of proposed suppliers and specialist installer(s).

Shop drawings

General: Submit shop drawings in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Submit shop drawings of brick and blockwork showing, but not limited to the following information:

- All design loads and design criteria.
- Setting out arrangements, including the heights of all openings.
- The type of brick and/or blockwork to be employed at each location.
- All service penetrations.
- All items which will be mounted on to brick or blockwork.
- All items provided by system wide contractors.
- Interfacing details with adjacent finishes and materials.

No. of copies to be submitted: As Particular Specification.

Engineering endorsement

Submit calculations and drawings from a Singapore licensed Professional Engineer concurrently with the shop drawings and showing, but not limited to, the following:-

Compliance with all relevant Singapore legislation and regulations.

Manufacturers' information

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

No. of copies to be submitted: 3.

Test Reports

Submit copies of current test reports, and certification, including drawings of tested details, in accordance with Section 20.3.2, 'Tests' of the General Requirements.

No. of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with Section 20.3.6 'Submissions' of the General Requirements.

100.2.6 TOLERANCES

General

Conform to the Tolerances Table.

Tolerances Table

Position or dimension	Permissible deviation (mm)
Cavity width	10
Horizontal or vertical position of a surface relative to a plane surface (bow) when measured as described in AS3700 Appendix G	3
Horizontal position at its base or at each storey level of any brick or block specified or shown in plan	15
Plumb in the total height of the building	25
Plumb of a storey relative to a vertical line through the base of the member	10
Position of a bed joint relative to horizontal, or from the level required	10mm in any 10m length 15mm in total
Position of any exposed brick surface relative to any adjacent exposed brick surface (the bow provision above also applies)	2
Relative position of bearing walls in adjacent storeys intended to be in vertical alignment	10
Reinforcement and tendons	
Across thickness of walls	5
Along the length of a wall or up the height of a wall	50
In a column or pier	5
Thickness of bed joint	3
Thickness of perpend	5

100.3 EXECUTION

100.3.1 MATERIALS AND COMPONENTS

Bricks and blocks

Burnt Clay and shale bricks: To SS 103.

Precast concrete blocks: To SS 271.

Durability: Below damp-proof course, use 'Exposure' category to AS/NZS 4456.10 Appendix A (Salt attack resistance categories).

Minimum age of clay bricks: 7 days.

Corrosion resistance

Built-in steel products: Conform to the **Corrosion resistance table**.

- Distance to water: To the mean high water mark.
- External: Includes external leaf and air spaces behind single skin brickwork or blockwork walls.
- Internal: Includes building fabric protected from salt and moisture by vapour barriers, sarking, sheathing and building wraps.

Corrosion resistance table

Corrosivity category	Situation	Lintels	Wall ties, connectors and other structural accessories	Flashings
Low More than 10 m from water subject to breaking surf More than 1 km from salt water not subject to breaking surf	Internal	Galvanize after fabrication 300 g/m ²	Galvanize after fabrication 300 g/m ² Metallic coated sheet Z275/AZ150 In line galvanized sections with after fabrication coating repair ILG/150	Metallic coated sheet Z275/AZ150
	External	Galvanize after fabrication 300 g/m ²	Galvanize after fabrication 300 g/m ² Metallic coated sheet Z600 Galvanized wire 300 g/m ²	Metallic coated sheet Z450/AZ200
Medium 1000 – 10,000 m from water subject to breaking surf More than 50 m from salt water not subject to breaking surf Non-heavy industrial areas	Internal	Galvanize after fabrication 300 g/m ²	Galvanize after fabrication 300 g/m ² Metallic coated sheet Z275/AZ150	Metallic coated sheet Z275/AZ150
	External	Galvanize after fabrication 600 g/m ²	Galvanize after fabrication 600 g/m ² Galvanized wire 470 g/m ²	Metallic coated sheet Z450/AZ200
High 200 – 1000 m from water subject to breaking surf Less than 50 m from salt water not subject to breaking surf Heavy industrial areas	Internal	Galvanize after fabrication 600 g/m ²	Galvanize after fabrication 470 g/m ²	Metallic coated sheet Z450/AZ200
	External	Stainless 316 Galvanize after fabrication 600 g/m ² plus organic coating	Stainless 316 Engineered polymer	Metallic coated sheet AZ200 plus organic coating

Connectors and accessories

Standard: To AS/NZS 2699.2.

Flashings and damp-proof courses

Standard: To AS/NZS 2904.

Mortar mixing

Measure volumes using boxes. Machine mix for at least six minutes.

Mortar materials

Additives or admixtures:

- Air-entraining agents: To AS 1478.1.
- Methyl-cellulose water thickeners: To be designed for use in brickwork or blockwork and accepted by the Engineer.
- Plasticizers or workability agents: To be designed for use in brickwork or blockwork, and accepted by the Engineer.
- Pigments: To BS EN 12878 or NZS 3117.

Lime: To AS 1672.1.

Masonry cement: To AS 1316.

Portland cement: To SS 26.

Proportions: Conform to the **Mortar mix table**.

Sand: To be fine aggregate with a low clay content and free from efflorescing salts, selected for colour and grading.

Water: To be clean and free from any deleterious matter.

White cement: To have iron salts content $\leq 1\%$.

Mortar mix table

Mortar class to AS 3700	Bricks or blocks			Water thickener
	Clay	Concrete	Calcium silicate	
Masonry cement				
M3	1:0:4	1:0:4	n/a	No
M4	1:0:3	n/a	n/a	No
Portland cement				
M1	0:1:3	n/a	n/a	No
	1:3:12	n/a	n/a	No
M2	1:2:9	n/a	n/a	No
M3	1:1:6	1:1:6	n/a	Optional
	1:0:5	1:0:5	1:0:5	Yes
M4	1:0.5:4.5	1:0.5:4.5	n/a	Optional
	1:0:4	1:0:4	1:0:4	Yes
	1:0 to 0.5:3	1:0 to 0.5:3	1:0 to 0.5:3	Optional

Protection from contamination

Protect masonry materials and components from ground moisture and contamination.

Steel lintels

Angles and flats: To AS/NZS 3679.1.

Cold formed proprietary lintels: To be designed to AS/NZS 4600.

Corrosion protection: To AS/NZS 2699.3.

Galvanizing: Do not cut after galvanizing.

Wall ties

Standard: To AS/NZS 2699.1: Type A.

Strength classification:

- Cavities > 60 mm wide: Heavy duty.
- Masonry veneer: Light duty.
- Normal cavity construction and at abutments: Medium duty.

100.3.2 BRICKWORK AND BLOCKWORK

Bond

Stretcher bond.

Building in

Embedded items: Build in wall ties and accessories as the construction proceeds. If it is not practicable to obtain the required embedment wholly in the mortar joint in hollow unit brickwork or blockwork, fill appropriate cores with grout or mortar.

Steel door frames: Fill the backs of jambs and heads solid with mortar as the work proceeds.

Construction at different rates or times

If two or more adjoining sections of masonry, including intersecting walls, are constructed at different rates or times, rake back or tie the intersections between those sections so that monolithic structural action is obtained in the completed work.

Holes and chases

If not required, do not cut holes and chases.

Do not cut holes and chases to a depth greater than 30% of the brick or block without acceptance by the Engineer.

Joining to existing

Do not tooth new masonry into existing work.

Joints

Lay solid and cored units on a full bed of mortar. Face-shell bed hollow units. Fill perpend solid. Cut mortar flush.

- Externally: Tool to give a dense water-shedding finish.
- Internally: If wall is to be plastered, rake not more than 10 mm to give a key.
- Thickness: 10 mm.nominal.

Joints and cutting

Set out bricks or blocks with joints of uniform width and minimise cutting of masonry units.

Setting out

If it appears that minor variations to joint widths will obviate cutting, submit proposals.

Monolithic structural action

General: Provide brick or block header units, except in stretcher bond facework.

Location:

- At engagement of engaged piers.
- At engagement of diaphragms with the leaves in diaphragm walls.
- At intersections of flanges with shear walls.
- At intersections with supporting walls and buttresses.
- Between leaves in solid masonry construction.

Rate of construction

Regulate the rate of construction to eliminate joint deformation, slumping or instability.

Rods

76 mm high units: 7 courses to 600 mm.

90 mm high units: 6 courses to 600 mm.

190 mm high units: 3 courses to 600 mm.

Weather protection

Keep the top surface of brickwork and blockwork covered to prevent the entry of rainwater.

100.3.3 FACEWORK

Cleaning

Clean progressively as the work proceeds to remove mortar smears, stains and discolouration. Do not use acid. Do not erode brickwork or blockwork.

Colour mixing

If the colour of the face units is visible, evenly distribute the colour range of units and prevent colour concentrations and “banding”.

Commencement

Commence at least 1 full course for blockwork, or 2 full courses for brickwork, below adjacent finished ground level.

Double face walls

Select face units for uniform width and double-face qualities in single-leaf masonry with facework both sides. Before starting, obtain a ruling as to which is the preferred wall face, and favour that face should a compromise be unavoidable.

Perforations

If perforations would otherwise be visible, use solid face units.

Perpends

Vertically align perpends in alternate courses.

Sills and thresholds

Solidly bed sills and thresholds and lay them so that the top surfaces drain away from the building. Set out so that no unit is cut smaller than 3/4 full width.

100.3.4 CAVITY WORK

Cavity clearance

Keep cavities clear at all times.

Cavity fill

Fill the cavity to 1 course above adjacent finished ground level with mortar weathered towards the outer leaf.

Cavity width

Brick or block walls: 50 mm.

Brick veneer walls: 25 mm, between the masonry leaf and the loadbearing frame and 40 mm between the masonry leaf and sheet bracing.

Openings

Treat the cavity at the jambs of external openings as shown on the accepted shop drawings.

Wall ties connectors and accessories

Install to prevent water passing across the cavity.

100.3.5 DAMP-PROOF COURSES

Location

General: Provide damp-proof courses as follows:

- Cavity walls built off slabs on ground: In the bottom course of the outer leaf, continuous across the cavity to drain to the outer face and up the inner face bedded in mortar, turned 30 mm into the inner leaf 1 course above.
- Masonry veneer construction: In the bottom course of the outer leaf, continuous horizontally across the cavity. Fasten to the inner frame 75 mm above floor level.
- Walls adjoining infill floor slabs on membranes: In the course above the underside of the slab in internal walls and inner leaves of cavity walls. Project 40 mm and dress down over the membrane turned up against the wall.

Height: Not less than

- 150 mm above the adjacent finished ground level;
- 100 mm above sandy well-drained areas that extend to the full depth of the footing system;
- 75 mm above the finished paved or concrete area.

Installation

Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints. Step as necessary, but not exceeding 2 courses per step. Sandwich damp-proof courses between mortar.

- Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses and waterproof membranes.

100.3.6 FLASHINGS

Location

Provide flashings and weatherings as follows:

- Floors: Full width of outer leaf immediately above slab or shelf angle, continuous across cavity and up the inner face bedded in mortar, turned 30 mm into the inner leaf 2 courses above. Where the slab supports the outer skin and is not rebated, bed the flashing in a suitable sealant.

- Under sills: 30 mm into the outer leaf bed joint 1 course below the sill, extending up across the cavity and under the sill.
- Over lintels to openings in cavity walls: Full width of outer leaf immediately above the lintel, continuous across cavity, turned 30 mm into the inner leaf 2 courses above. Extend at least 50 mm beyond the lintels.
- Over lintels to openings in masonry veneer construction: Full width of outer leaf immediately above the lintel, continuous across cavity. Turn up against the inner frame and fasten to it. Extend at least 50 mm beyond the lintels.
- At abutments with structural frames or supports: Vertical flashing in the cavity using 150 mm wide material, wedged and grouted into a groove in the frame opposite the cavity.
- At stiles where cavities are closed: Full height flashing extending 75 mm beyond the closure into the cavity, interleaved with the sill and head flashing at each end. Fix to frame stiles.

Installation

General: Sandwich flashings between mortar except where on lintels or shelf angles. Bed flashings, sills and copings in one operation to maximise adhesion.

Pointing: Point up joints around flashings, filling voids.

Weepholes

Location: Provide weepholes to external leaves of cavity walls in the course immediately above flashings, and cavity fill, and at the bottoms of unfilled cavities.

Form: Open perpend.

Maximum spacing: 720 mm.

100.3.7 WALL TIES

Location

Provide wall ties in conformance with the **Wall tie spacing table** and as follows:

- Opposite vertical lateral supports.

Installation

Embedment: At least 50 mm into mortar and ensure mortar cover is 15 mm minimum to the outside face of the mortar.

Flexible types: If ties or anchors extend across control joints, use ties or anchors which do not impair the effectiveness of the joint.

Water transmission: Install to prevent water passing across the cavity.

Wall tie spacing table

Location requirements	Maximum interval	
	Generally	Around openings and joints
76 mm high bricks		
- vertically	7 courses	Alternate 3 and 4 courses
- horizontally	2½ bricks	Alternate 1 and 1½ bricks
90 mm high bricks		
- vertically	6 courses	3 courses
- horizontally	2 bricks	1 brick
190 mm high blocks		
- vertically	3 courses	Alternate 1 and 2 courses
- horizontally	1 block	½ block
Masonry veneer walls		
- Top row of ties	Half the horizontal spacing and locate within 300 mm of top of wall	
- First row of ties above a horizontal floor support where veneer continues past support	Half the horizontal spacing and locate within 300 mm of support	

100.3.8 CONTROL OF MOVEMENT

Ageing of concrete

Minimum age of concrete supports to clay bricks: 28 days.

Contraction joints for concrete and calcium silicate masonry

Maximum length of continuous wall: 8 m.

Minimum width of control joint: 10 mm.

Expansion joints for clay brickwork

Maximum length of continuous wall: 15 m.

Minimum width of control joint: 15 mm.

Filler material

Provide compatible sealant and bond breaking backing materials which are non-staining to masonry. Do not use bituminous materials with absorbent masonry units.

- Bond breaking materials: To be non-adhesive to sealant, or faced with a non-adhering material.
- Foamed materials: To be closed-cell or impregnated, not water-absorbing.

Fire rated control joints

If a control joint occurs in an element of construction required to have a fire resistance rating, construct the control joint using fire stopping materials so that the fire resistance rating of the element is not reduced.

- Fire stopping: To AS 4072.1.

Joint filling

Installation: Clean the joints thoroughly and insert an easily compressible backing material before sealing.

Sealant depth: Fill the joints with a gun-applied flexible sealant for a depth of at least two-thirds the joint width.

100.3.9 BED JOINT REINFORCEMENT

Location

If required, locate as follows:

- In first 2 bed joints above and below head and sill flashings to openings.
- In first 2 bed joints above and below openings.
- In second bed joint below top of wall.
- In third bed joint above bottom of wall.

Maximum vertical intervals: 500 mm.

Installation

Lap 450 mm at splices. Fold and bend at corners so that the longitudinal wires are continuous. Stop 200 mm short of control joints.

- In brickwork: Extend 450 mm beyond each side of openings.

Reinforcement

Material: Galvanized welded wire mesh.

Width: Equal to the width of the leaf, less 15 mm cover from each exposed surface of the mortar joint.

100.3.10 REINFORCED AND GROUTED BLOCKWORK

General

Provide reinforcement and/or grouting in conformance with the **Reinforced and grouted blockwork schedule**.

Cleaning core holes

Provide purpose-made cleanout blocks or machine cut a cleaning hole at the base of each grouted core. Locate on the side of the wall which is to be rendered or otherwise concealed. Cover the hole with formwork and grout the core.

Grouting

Commencement: Do not commence until grout spaces have been cleaned out and the mortar joints have attained sufficient strength to resist blow-outs.

Height of lift: Limit the height of individual lifts in any pour to ensure that the grout can be thoroughly compacted to fill all voids and ensure bond between grout and masonry. Compact by vibration or by rodding.

Topping up: On the completion of the last lift, top up the grout after 10 min to 30 min, and vibrate or rod to merge with the previous pour.

100.3.11 STEEL LINTELS

Location

Provide 1 lintel to each wall leaf in conformance with the **Steel lintel schedule**.

Installation

General: Do not cut on site. Keep lintels 6 mm clear of heads of frames. Pack mortar between the angle upstand and supported masonry units. Install the long leg vertical.

Minimum bearing each end:

- Span ≤ 1000 mm: 100 mm.
- Span > 1000 mm: 150 mm.

Propping: To prevent deflection or excessive rotation, temporarily prop proprietary cold-formed lintels until the masonry reaches its required strength.

- Minimum propping period: 7 days.

100.3.12 ARCHES

Arch voussoirs

Cut units using a masonry saw.

Shapes and dimensions

Form arches using solid or cored (not hollow) masonry units.

100.3.13 BAGGING

Dry bagging

Application: Apply laying mortar to the surface using a hessian bag or similar. Flush up irregularities, but leave the minimum amount of mortar on the surface.

Preparation: Cut joints flush before bagging.

Textured bagging

Application: Apply laying mortar to the surface using a sponge float. Flush up irregularities, but leave approximately 2 mm of mortar on the surface. When initial set is reached, texture using a hand bristle brush.

Preparation: Cut joints flush before bagging.

100.3.14 SCHEDULES

Brick and block construction schedule

	Type or location		
	A	B	C
Bricks and blocks	>	>	>
Air vent units	>	>	>
Characteristic unconfined compressive strength	>	>	>
Dimensional category	>	>	>
Name or type	>	>	>
Salt attack resistance grade	>	>	>
Sill units	>	>	>
Threshold units	>	>	>
Work size	>	>	>
Built-in components	>	>	>
Damp-proof course type	>	>	>
Flashings material	>	>	>
Lintel type	>	>	>
Control joints	>	>	>

100 BRICK AND BLOCK CONSTRUCTION

	Type or location		
	A	B	C
Backing rod	>	>	>
Primer	>	>	>
Sealant	>	>	>
Width	>	>	>
Grout	>	>	>
Composition	>	>	>
Compressive strength	>	>	>
Mortar	>	>	>
Cement	>	>	>
Colour	>	>	>
Proportions or class	>	>	>
Sand	>	>	>
Unit joints	>	>	>
Bond	>	>	>
Depth	>	>	>
Shape or profile	>	>	>

Brick and block performance schedule

	Type or location		
	A	B	C
Compressive strength	>	>	>
Durability test	>	>	>
Flexural strength	>	>	>

Reinforced and grouted blockwork schedule

Application	Grout	Reinforcement		
		Bar type	No. of bars	Stirrups
>	>	>	>	>
>	>	>	>	>
>	>	>	>	>

Steel lintels schedule

Opening dimensions (mm)	Opening loading type	Dimensions (mm)		
		D1	D2	Thickness
>	>	>	>	>
>	>	>	>	>
>	>	>	>	>

100.4 COMPLETION

100.4.1 COMPLETION SUBMISSIONS

General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Operation and Maintenance Manual

On completion submit an Operation and Maintenance Manual in accordance with Item 20.5.3 'Operation and Maintenance Manuals' of the General Requirements.

Cleaning

Cross refer Item 100.4.1 'Cleaning' above.

Protection

Protect all brick and blockwork on site from damage until handover.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

On or before completion of the works remove all materials used as a means of protection.

Record drawings

Provide record drawings in accordance with Item 20.5.2, Record Drawings, of the General Requirements.

100.4.2 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.

110 STONE MASONRY

110.1 GENERAL

110.1.1 CROSS REFERENCES

General

Conform to the General Requirements worksection.

Associated worksections

Conform to associated worksections as follows: Metals and Prefinishes.

Heavy Duty Galvanised Coatings.

Adhesives Sealants and Fasteners.

>

110.1.2 CIVIL DEFENCE (CD) REQUIREMENTS

General

Where stations are identified as having Civil Defence (CD) requirements, refer to the CD Design Criteria for requirements and information relating to the upgrading of fixing methods for CD stations.

110.1.3 INTERPRETATION

Authority's Sample: A sample held by the Authority and available for viewing during the tender and construction periods.

110.1.4 DESIGN

Drawings

Contract drawings show generic design principles and design intent only.

110.1.5 STANDARD

General

Masonry: To AS 3700.

110.1.6 DEFINITIONS

Finishes

To the definitions of the American National Building Granite Quarries Association Inc. Viz:-

- Polished : Mirror glass with sharp reflections.
- Honed : Dull sheen, without reflections.
- Flamed : Produced by the application of high temperature flame to the surface. Large surfaces may not have shadow lines caused by the overlapping of the torch.
- Fine Rubbed : Smooth and free from scratches – no sheen.
- Shot ground : Plane surface with pronounced circular markings or trails having no regular pattern.
- Sand blasted, coarse stippled : Coarse plane surface produced by blasting with an abrasive, coarseness varies with type of preparatory finish and grain structure of the granite.
- Sand blasted, line stippled : Plane surface, slightly pebbled with occasional slight trails or scratches.
- 8-cut : Fine bush hammered.
- 6-cut : Medium bush hammered.
- 4-cut : Coarse bush hammered.

Saw cut: The finish obtained from the saw used to cut the granite.

110.2 QUALITY

110.2.1 INSPECTION

Witness points

Give sufficient notice so that inspection may be made of the following:

- Completion of all sample panels.
- Lintels in position.
- Proposed stone source (quarry, storage yard).
- Proposed mason's yard.
- Materials stored at the yard or on site.
- Stone laid out before fixing.

- Subbase prepared to receive the specified stonework.
- Items to be built-in located in their correct positions, including damp-proof course, flashings, bolts, cramps, brackets, structural metalwork and rainwater goods.
- Control joints ready for insertion of joint filler.

Hold points

- Completion of each confirmation prototype.

Corrosion

Cross refer: General Requirements Clause 20.4.1.

110.2.2 TESTS

General

Carry out all tests in accordance with Section 20.3.2 'Tests' of the General Requirements.

Obtain test samples, representative of each required type of stone, and have the tests carried out at the following stages:

- Before awarding a stone supply contract.
- On dimension stone prepared for the works, at intervals during the course of the works.

Natural stone tests schedule

Property to be tested	Test standard	Test criterion (if not in the test standard)	Number and frequency of tests
Unconfined compressive strength (dry and saturated): - Intact rock core specimens	ASTM D2938	131 MN/m ²	>
- Dimension stone	ASTM C170	>	>
Surface absorption rate	ASTM C97	Maximum 0.4%	>
Porosity	ASTM C97	>	>
Wet and dry density	ASTM C97	Minimum 2560kg/m ³	>
Modulus of rupture	ASTM C99	10.34MN/m ²	>
Sodium sulphate soundness	>	>	>
Flexural strength	ASTM C880	>	>
Permeability of water	AS/NZS 4456.16	>	>
Other properties	>	>	>

Cast stone tests schedule

Property to be tested	Test standard	Test criterion (if not in the test standard)	Number and frequency of tests
Compressive strength	BS 1217	>	>
Drying shrinkage	BS 1217	>	>
Initial surface absorption	BS 1217	>	>
Other properties	>	>	>

Mortar tests schedule

Property to be tested	Test standard	Test criterion (if not in the test standard)	Number and frequency of tests
Compressive strength	AS 2701.4	>	>
Bulk density	>	>	>
Soluble silica and calcium oxide content	AS 2701	>	>

Sand and aggregates

To SS73.

Installed sealant tests

Cross refer: Adhesives, Sealants and Fasteners.

Structural fixings tests

Cross refer: Adhesives, Sealants and Fasteners.

Slate tests schedule

Property to be tested	Test standard	Test criterion (if not in the test standard)	Number and frequency of tests
Delamination	BS 5642:1	>	>
Sulphuric acid immersion test	BS 5642:1	>	>
Flexure	ASTM C120	>	>
Water absorption	ASTM C121	>	>
Weather resistance	ASTM C217	>	>

110.2.3 SAMPLES

General

Submit samples of each of the following in accordance with Section 20.3.4 ‘Samples’, of the General Requirements.

No. of samples: 3 unless otherwise noted below.

Size of samples: As noted below.

Stone samples

Stone units: For each type and grade of stone (including natural, cast, and synthetic stone), submit at least 6 quality control samples of each stone unit (e.g. block, panel, tile)

- either the full size of the unit, or 300 x 300 mm, whichever is the greater; and
- showing the expected range of variation of colour, pattern, texture, and surface finish in stone to be supplied.

Cast stone: Submit samples which consist of both facing and backing material, if different.

Associated materials and products

Sand: Submit a 2 kg sample of sand required to be from a particular source, or of a particular colour, or of a particular particle size distribution. Include a sieve analysis for particle size distribution.

Accessories: Submit samples of each accessory proposed for fixing stonework.

Bird proofing

Fixing: Submit samples of proposed fixing methods and materials, including adhesives.

110.2.4 PROTOTYPES

General

Construct all prototypes in accordance with the requirements of Section 20.3.5, ‘Prototypes’ of the General Requirements.

Provide a confirmation prototype of all stone masonry installations.

Location: As agreed with the Engineer.

Minimum size (face of panel) (mm): Panel height x 3.0m length.

- Incorporating
- Door opening.
 - Service outlets as identified by the Engineer.
 - Corner.
 - Joint finishes (including mortar pointing and sealant).

Footings: >

Retain all prototypes until the completion of the works or as directed by the Engineer.

110.2.5 SUBMISSIONS

General

Submit in accordance with section 20.3.6, ‘Submissions’ of the General Requirements.

Subcontractors

Submit name and contact details of proposed specialist stoneworker.

Design

Bird proofing: Submit details of the proposed method together with evidence of proven performance including addresses of existing installations, date of installation, contact personnel at the installation addresses, brief history of the installations, and current performance data.

Submit calculations and drawings from a Singapore licensed Professional Engineer concurrently with the shop drawings and showing, but not limited to, the following:-

- Compliance with all relevant Singapore legislation and regulations.

Materials

Technical Literature: Submit the manufacturer's technical literature for all proprietary materials used together with certification that materials comply with the required standards in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Instructions: Submit copies of relevant manufacturers' instructions including standard drawings and details.

Material safety data sheets (MSDS): Submit MSDS.

Proposed mortar mix: Submit details of the proposed mix, at least 7 days before commencing stonework.

Supplier's data: Submit statements from the stone supplier, with the following information:

- The supplier's experience in the required type of work.
- Production capacity for material of the required type, sizes and quantity.
- Particulars of established quality control procedures (if any), and the category of the procedures to the relevant standard.
- The physical properties of the required material.
- Lead times for delivery of the material to the site.

Shop drawings and schedules

General

Submit shop drawings in accordance with Section 20.3.6, 'Submissions' of the General Requirements.

Submit shop drawings showing, but not limited to, the following:

- All design loads and design criteria.
- Setting out arrangements, including the heights of all openings.
- Projecting courses.
- Quoin stones.
- Cutting details for mouldings such as lintels, sills, steps and cornices.
- Stonework setting out.
- Position and identifying number of each stone.
- Dimensions of each stone and lay of natural bed.
- Lifting detail and fixing detail of each stone.
- Interfaces with adjacent building elements.
- Typical anchoring and supporting devices.

No. of copies to be submitted: As Particular Specification.

Check dimensions of all supporting and adjacent structure on site prior to the submission of shop drawings. Ensure drawings are based on site dimensions.

Submit and keep up to date, a detailed stonework phasing schedule.

Engineering Endorsement

Submit calculations and drawings from a Singapore licensed Professional Engineer concurrently with the shop drawings and showing, but not limited to, the following:-

Compliance with all relevant Singapore legislation and regulations.

Test Reports

Submit copies of current test reports, and certification, including drawings of tested details, in accordance with Section 20.3.2, 'Tests' of the General Requirements.

No. of copies to be submitted: 3.

Method Statement

General: Submit method statements in accordance with Section 20.3.6 'Submissions' of the General Requirements.

Submit the names and qualifications of proposed bench masons.

110.3 MATERIALS AND COMPONENTS

110.3.1 NATURAL STONE

General

Provide natural stone, which is:-

- of the appropriate quality grade for the purpose;
- of uniform quality within that grade;
- selected for the optimum matching of visual properties such as colour and pattern; and
- sound and free from defects liable to affect its strength, appearance, durability or proper functioning under the intended conditions of use.

Use “non-rusting” granites (i.e. granites that do not develop rust spots or patches).

Stone types

Granite: Igneous stone (e.g. granite) obtained from quarry stone extracted in blocks sufficiently large to suit the project requirements, and containing no more than a small degree of microcracking.

Limestone: Sedimentary stone.

- Oolitic limestone.
- Travertine.
- Magnesian Limestone.

Slate: Metamorphic stone.

Stone selection

Grading: Select stone of the appropriate quality grade for particular purposes.

Matching: Within each grade, select stone for the optimum matching of visual properties such as colour and pattern.

Source of stone supply

Nominated source: >

Alternative source: >

110.3.2 TOLERANCES

Dimension stone units

Maximum deviation from required dimensions:

- Loadbearing stones: ± 2 mm.

110.3.3 MORTAR

Mortar materials

Cement: Portland Cement to SS26.

White cement: Iron salts content $\leq 1\%$.

Lime: To AS 1627.1.

Sand: Fine aggregate with a low clay content and free from efflorescing salts, selected for colour and grading.

- Crushed stone: Fine aggregate consisting partly or wholly of crushed stone, made from material of the same type as the stone facing.

Sand for facework:

- Colour: >
- Grading: >
- Source: >

Admixtures: Do not provide admixtures.

Coloured mortar:

- Colour: >
- Location: >

Premixed mortar: >

Sand aggregate grading schedule

Sieve aperture (mm)	Percentage passing (by mass)
>	>
>	>
>	>

Mortar mix

Batching: Batch by weight and machine mix.

Mix compressive strength: \leq compressive strength of the stone bedded on it.

Mix permeability: \geq stone permeability.

Preparing lime putty:

- Using hydrated lime: Add lime to water in a clean container and stir to a thick creamy consistency. Leave undisturbed for at least 16 hours. Remove excess water and protect from drying out.
- Using quicklime: Run to putty as soon as possible after receipt of quicklime. Partly fill clean container with water, add lime to half the height of the water, then stir and hoe ensuring that no lime remains exposed above the water. Continue stirring and hoeing for at least 5 minutes after all reaction has ceased, then sieve into a maturing bin. Leave undisturbed for at least 14 days. Protect from drying out.

Mortar proportions (cement: lime: sand) >

Grout

Composition: >

Characteristic compressive strength (MPa): >

Sand stockpile

Before commencing stonework, stockpile sand sufficient for the whole of the works. Keep stockpiled sand dry.

110.4 EXECUTION

110.4.1 BENCH MASON

Supervision

Arrange to have on site a bench mason qualified to supervise stonework fixing and site adjustments to joints and surface finishing.

110.4.2 WORKMANSHIP GENERALLY

Storing

Store stone so that it is protected from the weather and atmospheric pollution, clear of the ground on its natural bed, on supports which do not locally overstress it, and in conditions suitable to promote good seasoning without staining, marking or damage.

Cutting

Perform the necessary cutting and shaping of stone to designated profiles including weathering, jointing, chasing, forming grooves and drilling for handling and fixing. Work the bed, face and back joints of the stone square and true.

Carving and moulding

Achieve a clean sharp finish.

Visual variations

If the quality control sample panels have a range of variation in colour, pattern, texture or surface finish, distribute the production panels throughout the work so that local concentrations of similar variations do not occur.

Tolerances schedule

Stone unit type	Dimension type	Tolerance
>	>	>
>	>	>
>	>	>

Cleaning

General: Clean masonry progressively as the work proceeds. Clean facework to remove mortar smears, stains and discolouration. Do not use acid.

110.4.3 LAYING UNITS

Bedding

Remove dust and foreign material from the bedding surfaces. If necessary adjust the moisture content of the stone units so that adverse effects, such as reduced bond, are kept within acceptable limits.

Where possible, bed and joint the stone in one operation. Lay each stone on a full bed of mortar.

Solidly fill and grout vertical joints, joggles and cramps as the work proceeds. Point up joints around flashings as necessary.

Natural bed

Lay loadbearing sedimentary stone or slate with its natural bed normal to the load (e.g. horizontal in walling, perpendicular to the line of thrust in arch voussoirs), except for the following:

- Overhanging projecting stones (cornices and string courses): Where edge bedding is required, lay each stone with its natural bed vertical and at right angles to the wall.
- Cladding panels: In non-loadbearing cladding panels, form each panel with its natural bed at right angles to the face.

Edge bedding >

Temporary support

General: Provide support as necessary to the stone while the mortar is curing, using bracing, joint spacers, or both.

Bracing and joint spacers: Non-damaging and non-staining softwood wedges or laths soaked in water. Do not allow metal pinch bars to bear directly on the stone.

Racking and toothing

Raise advanced work no more than 1.5 m above the general level, and rack back. Do not tooth stonework for subsequent additions except where toothing is shown on the drawings.

Bonding

Bond the masonry as required, and as necessary to provide stability and monolithic structural action to the stonework assembly.

Wall type

Cavity width (mm): >

Stonework type

Bond: >

Course height (mm): >

Facing finish: >

Tolerances

- Vertically: +/-3mm in 3.0m, +/- 6mm for 6.0m maximum.
- Horizontally: +/-3mm.
- On plan: +/-3mm in 6.0m.
- Offset at joints: +/-1.5mm.

Tolerances are not accumulative.

110.4.4 FIXINGS

Provision of fixings

If the necessary fixings for stonework are not otherwise provided as part of the structure provide suitable fixings sufficient to support and restrain each stone and effectively resist the dead and live loads to which it will be subject in service.

Metals for fixings

Non-ferrous metal or stainless steel, stamped for identification, compatible with the materials with which they will be in contact and effectively insulated from electrochemical reaction with incompatible materials.

110.4.5 BIRD PROOFING

Performance

Provide a system which

- is defensive against current infestation and reinfestation;
- does not rely on chemical attack, sterilisation, poisoning or predators;
- is durable in the installed location; and
- does not present a safety hazard to persons working on the facade for purposes such as window cleaning, maintenance and access to equipment.

Fixing to stonework

Comply with the requirements for structural fixings.

110.5 STONE ELEMENTS

110.5.1 DAMP-PROOF COURSES

Material

Standard: To AS/NZS 2904.

Type: >

Location

General: Provide damp-proof courses in the following locations, if applicable:

- Walls adjoining infill floor slabs on membranes: In the course above the underside of the slab in internal walls and inner leaves of cavity walls. Project 40 mm and dress down over the membrane turned up against the wall.
- Cavity walls built off slabs on ground: In the bottom course of the outer leaf, continuous horizontally across the cavity and up the inner face bedded in mortar, turned 30 mm into the inner leaf 1 course above. Project 10 mm beyond the external slab edge and turn down at 45°.
- Masonry veneer construction: In the bottom course of the outer leaf, continuous horizontally across the cavity. Fasten to the inner frame 75 mm above floor level. Project 10 mm beyond the external slab edge and turn down at 45°.
- Internal walls built off slabs on ground: In the first course above floor level.

Installation

General: Lay in long lengths. Lap full width at angles and intersections and at least 150 mm at joints. Step as necessary, but not exceeding 2 courses per step. Sandwich damp-proof courses between mortar.

Junctions: Preserve continuity of damp-proofing at junctions of damp-proof courses and waterproof membranes.

Location: At least 150 mm above adjacent finished ground level.

Lap sealing: >

110.5.2 FLASHINGS AND WEATHERINGS

Material

Standard: To AS/NZS 2904.

Type: >

Location

General: Provide flashings and weatherings in the following locations, if applicable:

- Under sills: 50 mm into the outer leaf bed joint 1 course below the sill, extending up across the cavity and under the sill.
- Over lintels to openings in cavity walls: Full width of the outer leaf immediately above the lintel, continuous across cavity, turned 50 mm into the inner leaf 2 courses above. Extend at least 50 mm beyond the lintels.
- At abutments with structural frames or supports: Vertical flashing in the cavity using 150 mm wide material, wedged and grouted into a groove in the frame opposite the cavity.
- At stiles where cavities are closed: Full height flashing extending 75 mm beyond the closure into the cavity, interleaved with sill and head flashings at each end. Fix to frame stiles.

Lap sealing >

Weepholes

Form: Open perpend 300 mm high, at least 8 mm wide.

Maximum spacing: 1000 mm.

Location: Provide weepholes to external leaves of cavity walls in the course immediately above flashings, damp-proof courses, lintels and supporting ledges.

110.5.3 WALL TIES

Wall ties

Stainless Steel.

Durability classification to AS/NZS 2699.1: >

Wall ties category table

Classification to AS/NZS 2699.1	Service conditions
Medium duty	Normal cavity construction
Medium duty	Tie bonding at abutments
Heavy duty	Cavities > 60 mm wide

Wall ties installation

Fixing of masonry veneer ties at abutments:

- To structural supports: >

Spacing: >

Embedment of wall ties

Cavities > 60 mm wide: 75 mm minimum.

Flexible wall ties

Type: Where ties or anchors extend across control joints, provide ties or anchors which do not impair the effectiveness of the joint.

110.5.4 JOINTING AND POINTING

General

Carry out jointing and pointing simultaneously to form a homogeneous bed.

Column and mullion joints

Method: Bed the joints in stone columns and mullions in mortar and

- joggle the bed joints to prevent movement;
- dowel the stones together with suitable restraint fixings; or
- make column joints over a concealed lead pad with the centre cut out to allow for settlement.

Joints

Size (mm): >

Jointing material: >

Pointing material: >

110.5.5 SEALANT JOINTING

Preparation for jointing

Immediately before jointing remove loose particles from the joint, using oil-free compressed air.

Taping

Protect the stonework surface on each side of the joint using 50 mm wide masking tape or equivalent means. On completion of pointing remove the tape and remove any stains or marks from the stonework surface.

Jointing materials

General: Use recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not use bituminous materials on absorbent surfaces.

Priming: Apply the recommended primer to the surfaces in contact with sealant materials.

Sealant colour: >

Foamed materials (in compressible fillers and backing rods): Closed cell or impregnated types which do not absorb water.

Bond breaking: Use backing rods, and other back-up materials for sealants, which do not adhere to the sealant.

Sealant proportions

Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Sealant application

Apply the sealant to dry joint surfaces using a pneumatic applicator gun. Do not apply the sealant in unsuitable weather conditions (e.g. when the ambient temperature is outside the range 5 – 50°C) or outside the recommended working time for the material or the primer.

Joint finish

Produce a smooth, slightly concave surface using a tool designed for the purpose.

Protection

Protect the joint from inclement weather during the setting or curing period of the material.

Edge to edge joints

Method of sealing: >

110.5.6 SURFACE TREATMENTS

Abutting surfaces

General: Seal concealed faces of stone walling or facing panels where they abut brickwork or concrete.

Sealing material: Fluorosilicate penetrating sealant to the Engineer's acceptance.

Dissimilar stones

Isolation: Isolate contact surfaces of dissimilar types of stone with a membrane. Isolate sedimentary stonework from brickwork and other masonry to prevent salts movement.

Isolating membrane material: >

110.6 COMPLETION

110.6.1 COMPLETION SUBMISSIONS

General

Cross refer: Item 20.5 'Completion' of the General Requirements.

Operation and Maintenance manual

On completion submit an Operation and Maintenance Manual in accordance with Item 20.5.3 'Operation and Maintenance Manuals' of the General Requirements.

Set out a program for regular maintenance cycles at not more than five-year intervals. Include stonework cleaning, desalination, inspection and repair of joints and flashings, checking rainwater goods for blockages and breakdown, and detection of potential failures arising from movement or other causes. Include particulars of stone source, type of stone, and jointing materials.

Protection

Protect all stonework on site from damage until handover.

Temporary measures: submit details of all proposed temporary protection measures to the Engineer for acceptance.

On or before completion of the works remove all materials used as a means of protection.

Cleaning

Cleaning: Leave the stonework clean on completion.

Record drawings

Provide record drawings in accordance with Item 20.5.2, Record Drawings, of the General Requirements.

110.6.2 REPAIR

Before commencing repairs submit details of the proposed repair method for acceptance.