1 GENERAL

1.1 PRE-CONSTRUCTION WORK

The Engineer and Contractor will carry out a joint condition-in survey using video or digital photographs to record the condition of the site upon handover to the Contractor. This will determine the state of the site that the Contractor must hand back upon completion of the works. The Contractor will carry out a detailed site set out survey for the works.

A Pre-Construction Meeting will be held between the Engineer and the Contractor to review the following information:

- Condition-in Survey
- Site Survey
- Work Method Statement
- Program
- Schedule of Materials and Installed Equipment

If the Engineer approves the above documentation, then the Contractor will be issued with the Notice to Proceed. If the documentation is incomplete, the Contractor will have 3 calendar days to revise and resubmit the documentation for approval.

The contract period begins on the day the Notice to Proceed is issued.

The Contractor must mobilise on the project site within 7 calendar days of the date of issue of the Notice to Proceed.

Site restrictions
Site security limitations: Comply with any restrictions on site area, access or working times advised by the Engineer.
Access: Access on to and within the site, use of the site for temporary works and constructional plant, including working and storage areas, location of offices, workshops, sheds, roads and parking, is restricted to the areas shown on the drawings or as agreed with the Engineer.

Occupied areas of site or buildings
For the parts of the site designated as occupied areas in the Occupied areas schedule:
- Allow occupants to continue using the area for the required period.
- Make available safe access for occupants.
- Arrange work to minimise nuisance to occupants and ensure their safety.
- Protect occupants against weather, dust, dirt, water or other nuisance, by such means as temporary screens.

Protection of persons and property
Temporary works: Provide and maintain required barricades, guards, fencing, shoring, temporary roadways, footpaths, signs, lighting and traffic flagging.
Accessways, services: Do not obstruct or damage roadways and footpaths, drains and watercourses and other existing services in use on or adjacent to the site. Determine the location of such services. If damage occurs, immediately repair it at the Contractors cost.
Property: Do not damage property which is to remain on or adjacent to the site, including adjoining property encroaching onto the site. If damage occurs, immediately repair it at the Contractors cost.
Existing services
Attend to existing services as follows:
- If the service is to be continued, repair, divert or relocate as required.
- If the service is to be abandoned, cut and seal or disconnect, and make safe.
Submit proposals to the Engineer for action for existing services before starting this work. Minimise the number and duration of interruptions.

Adjoining property
Records: For properties described in the Adjoining properties to be recorded schedule:
- The Contractor is to inspect the properties with the Engineer and owners and occupants of the properties, before start of work.
- Make detailed records of conditions existing within the properties, especially structural defects and other damage or defacement.
- Arrange for at least 2 copies of each record, including drawings, written descriptions, and photographs, to be endorsed by the owners and occupants, or their representatives, as evidence of conditions existing before commencement of work.
Submit one endorsed copy of each record to the Engineer. The Contractor is to keep the other endorsed copy.

1.2 CONSTRUCTION PLANT
Access
Access route and site access point are as shown on the drawings or as agreed with the Engineer.

Use of existing services
Existing services may be used as temporary services for the performance of the contract subject to conditions stated in the Existing services schedule.

Contractors Facilities and Work Practices
The Contractor is required to provide adequate toilet and washroom facilities for his staff. These facilities shall be kept clean and serviceable at all times.
The Contractor is required to provide adequate first aid equipment on-site, failure of the Contractor to ensure the availability of first aid equipment on-site will result in an immediate ‘stop work’ order being issued. All costs and time delays resulting from any such ‘stop work’ order are entirely the Contractors responsibility.
A site office will be established by the Contractor at the work site. The location of the site office will be identified by the Engineer to the Contractor. The office will have a complete set of the contract documents.
The Contractor is to maintain a safe, healthy and tidy worksite at all times and all work activities are to be performed with protective and safety equipment appropriate for the task. The Contractor is entirely responsible for workplace safety and unsafe work practices will be identified and recommendations made for revised work methods as appropriate.

Project signboards
Provide project-specific signboards and the following:
- Location, size and wording as directed by Engineer.
- Maintain in good condition for duration of the work.
- Remove on completion.
Obtain approval before display of advertisements or provision of other signboards.

1.3 BUILDING THE WORKS
Surveys
Setting out: Set out the works from the dimensioned drawings
Check surveys: Check the setout regularly on site
Final survey: Confirm final setout of roads, services and buildings on the as constructed drawings after Practical Completion

Survey marks
Definition: The term “survey mark” means a survey peg, bench mark, reference mark, signal, alignment, level mark or any other mark used or intended to be used for the purpose of setting out, checking or measuring the work.
Care of survey marks: Preserve and maintain the survey marks in their true positions. If the survey marks are damaged, immediately advise the Engineer and rectify the damage.

Contractor’s representative
The contractor must employ a suitably experienced engineer as the Site Manager. This person must be on site during working hours, and fluent in English and technical terminology. The Contractor’s Site Manager will have the authority to make all decisions concerning the project

Program of work
The Contractor is to provide a construction program which has the following information:
- Sequence of work.
- Allowance for holidays.
- Activity inter-relationships.
- Periods within which various stages or parts of the work are to be executed.
Time scale: Working days.
Update the program weekly. Identify changes since the previous version, and show the estimated percentage of completion for each item of work.

Site meetings
Hold and attend weekly site meetings throughout the contract and ensure attendance of appropriate subcontractors, the Site Manager and Engineer. The meeting schedule may be modified by the Engineer.
The meeting will consider the following items:
- Technical issues.
- Commercial issues.
- Program.
- Quality of work.
The Contractor is to keep minutes of site meetings. Within 3 working days after each meeting, submit to each party written copies of the minutes.

Items supplied by owner
Materials and other items identified in the Items to be supplied schedule will be supplied free of charge to the Contractor for installation in the execution of the works. Unload and take delivery of them, inspect them for defects and then take care of them. If defects are found, advise. Return unused items to the owner.

1.4 COMPLETION OF THE WORKS
Final cleaning
Before Practical Completion, clean throughout, including interior and exterior surfaces exposed to view. Clean carpeted and soft surfaces. Clean debris from the site, roofs, gutters, downpipes and drainage systems. Remove waste and surplus materials.
Reinstatement
Before practical completion, clean and repair damage caused by installation or use of temporary work and restore existing facilities used during construction to original condition.

Adjoining property
At practical completion, for properties described in the Adjoining properties to be recorded schedule inspect the properties with the Engineer and owners and occupants of the properties, recording any damage that has occurred since the pre-commencement inspection.

Post construction Works
The Contractor will provide the following documentation after all site construction has been completed:
- Warranty Statement
- Material Test Certificates
- As-Built Drawings
A condition-out survey will be conducted with the Contractor and Engineer at which damages caused by the Contractor will be identified. The Engineer will determine if the Contractor is to make repairs or if the damage will be deducted from the Contractor’s final invoice.

Removal of plant
Within 10 working days after practical completion, remove temporary works and construction plant no longer required. Remove the balance before the end of the defects liability period.

1.5 PAYMENT FOR THE WORKS
Anticipated progress claims schedule
The Contractor is to submit a schedule of anticipated progress claims which will be made throughout the contract. Submit a revised schedule with each progress claim.

1.6 MISCELLANEOUS
Compliance with the law
The Contractor is responsible for compliance with all requirements of authorities. The owner, before entering into the contract, has given the notices, paid the fees, and obtained the permits, approvals and other authorisations stated in the Prior applications and approvals schedule.
1 GENERAL

1.1 CONTRACT DOCUMENTS

Drawings
Large scale drawings take precedence over small scale drawings. Written or calculatable dimensions take precedence over scaled dimensions.
If there are any errors in dimensions, set out or size, immediately notify the Engineer.

Bill Of Quantities
If there are any errors in description of items or omissions in the BOQ, immediately notify the Engineer.
If there are any items which are unclear or are not available within the project program, immediately notify the Engineer.

Services diagrammatic layouts
Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.
Before commencing work:
- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.

Site Levels
Spot levels and identified levels on drawings take precedence over contour lines and ground profile lines.

1.2 INSPECTION

Inspection Notification Schedule
The Contractor is to notify the Engineer when the items identified in the Inspection Notification Schedule are ready for inspection.

Notice
Minimum notice for inspections to be made on site is 24 hours for off site personnel, 4 hours for onsite personnel.
If notice of inspection is required in respect of parts of the works that are to be concealed, advise when the inspection can be made before concealment.

1.3 SUBMISSIONS

Samples
Submit nominated samples for approval of the Engineer.
If it is intended to incorporate samples into the works, submit proposals for approval. Only incorporate samples in the works which have been approved. Do not incorporate other samples.
Keep endorsed samples in good condition on site, until practical completion.

Shop drawings
General: If required, submit dimensioned drawings showing details of the fabrication and installation of services and equipment, including relationship to building structure and other services, cable type and size, and marking details.
Diagrammatic layouts: Coordinate work shown diagrammatically in the contract documents, and submit dimensioned set-out drawings.
2 PRODUCTS

2.1 TESTS

Notice
Give notice of time and place of nominated tests.

Attendance
The Contractor is to carry out and attend all tests where nominated in this specification.

As a minimum, the Contractor will carry out the following tests:

- Flatness of the sub-base (allowed tolerance is ±2 cm using the 4 Lm bar test), to be certified on site.
- Flatness of the base of foundations (allowed tolerance is ±2 cm using the 4 Lm bar test), to be certified on site.
- Testing of the granulometric composition and strength of all aggregates to be used.
- Testing of all concrete in accordance with the regulations and methods as stated in Concrete section of the specification.
- Bricks shall have certified crush strength of greater than 105kg/cm2.
- Upon completion of the electrical installation a test and measurement of the earth reading for the building is to be undertaken. The results of this test are to be certified by a properly qualified electrical engineer and the results are then to be presented to the Engineer for acceptance.
- Full load testing and commissioning of all components of the electrical system is to be included for the various components of the electrical system. The electrical works will not be approved until the entire system has been successfully tested and signed off in the presence of a suitable qualified Theengineer.
- The Contractor will supply all necessary appliances and labor for testing of the complete water supply system at such time and as directed by the Engineer. Such testing shall as a minimum require the pressurizing of the complete water supply system to a pressure of not less than 4.5bar. The pipe work and fittings shall retain this pressure for a minimum of 1 hour following the commencement of the test.
- All drains shall be hydraulically tested to a minimum of 1500 mm head and no drains shall be covered up until such test has been made and repeated as necessary until passed to the approval of the Engineer. Access plugs and caps shall be removed, greased, refitted and made sound prior to the final testing.

2.2 MATERIALS AND COMPONENTS

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

Manufacturers’ or suppliers’ recommendations
Proprietary items: 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.
Proprietary systems/assemblies: Assemble, install or fix in accordance with the current written recommendations and instructions of the manufacturer or supplier.
Project modifications: Advise activities that supplement, or are contrary to, manufacturer’s or suppliers’ written recommendations and instructions.

Proprietary items
Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.
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 and advise consequent costs.

3 EXECUTION

3.1 COMPLETION

Warranties
Name the owner as warrantee in conformance with the Warranty schedule. Register with manufacturers as necessary. Retain copies delivered with components and equipment. Commencement: Commence warranty periods at practical completion or at acceptance of installation, if acceptance is not concurrent with practical completion.

3.2 OPERATION AND MAINTENANCE MANUALS

General
General: Submit operation and maintenance manuals for installations.

Format – hard copy
These will be A4 size loose leaf, in commercial quality files with hard covers, each indexed, divided and titled. Include the following features:
- Cover: Identify each binder with typed or printed title “OPERATION AND MAINTENANCE MANUAL”, to spine. Identify title of project and date of issue.
- Drawings: Fold drawings to A4 size and accommodate them in the files so that they may be unfolded without being detached from the rings.
- Text: Manufacturers’ printed data, including associated diagrams, or typewritten, single-sided on paper, in clear concise English.

Number of copies: 3.
1 GENERAL

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Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.
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- Flatness of the base of foundations (allowed tolerance is ±2 cm using the 4 Lm bar test), to be certified on site.
- Testing of the granulometric composition and strength of all aggregates to be used.
- Testing of all concrete in accordance with the regulations and methods as stated in Concrete section of the specification.
- Bricks shall have certified crush strength of greater than 105kg/cm².
- Upon completion of the electrical installation a test and measurement of the earth reading for the building is to be undertaken. The results of this test are to be certified by a properly qualified electrical engineer and the results are then to be presented to the Engineer for acceptance.
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Project modifications: Advise of activities that supplement, or are contrary to, manufacturer’s or suppliers’ written recommendations and instructions.

Proprietary items
Identification of a proprietary item does not necessarily imply exclusive preference for the item so identified, but indicates the necessary properties of the item.
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 and advise consequent costs.

3 EXECUTION

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- Text: Manufacturers’ printed data, including associated diagrams, or typewritten, single-sided on paper, in clear concise English.
Number of copies: 3.
1 GENERAL

1.1 INTERPRETATION

Demolished materials classes
Salvaged for re-use: Demolished materials scheduled for re-use in the works.
Salvaged for disposal: Demolished materials scheduled for re-use elsewhere.
Demolished for re-use: Non-scheduled demolished materials proposed by contractor for re-use in the works.
Demolished for removal: Other demolished materials.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Adjacent structures before commencement of demolition.
- Propping of structures prior to demolition works.
- Structure after stripping and removal of roof coverings and other external cladding.
- Underground structures after demolition above them.

2 PRODUCTS

2.1 DEMOLISHED MATERIALS

Demolished materials
Ownership: Ownership of demolished materials is described in the Demolished materials classes table.
Reuse: If it is proposed to reuse demolished materials in the works, submit proposals.
Salvage: Recover without damage materials to be salvaged, for reuse in conformance with the Salvaged materials for reuse schedule or for disposal in conformance with the Salvaged materials for disposal schedule.
Removal: Remove from the site demolished materials which are the property of the contractor. Do not burn or bury on site.
Transit: Prevent spillage of demolishing materials in transit.

3 EXECUTION

3.1 SUPPORT

Temporary support
If temporary support is required, certification for its design and installation is required from a professional engineer engaged by the contractor.
Until permanent support is provided, provide temporary support for sections of existing buildings which are to be altered and which normally rely for support on work to be demolished.
Support excavations for demolition of underground structures. Provide supports to adjacent structures where necessary, sufficient to prevent damage resulting from the works.

Permanent supports
If permanent supports for adjacent structures are necessary and are not described, give notice and obtain instructions.
3.2 PROTECTION

Encroachment
Prevent the encroachment of demolished materials onto adjoining property, including public places.

Weather protection
If walls or roofs are opened for alterations and additions or the surfaces of adjoining buildings are exposed, provide temporary covers to prevent water penetration. Provide covers to protect existing plant and equipment and materials intended for re-use.

Dust protection
Provide dust-proof screens, bulkheads and covers to protect existing finishes and the immediate environment from dust and debris.

Security
If a wall or roof is opened for alterations and additions, provide security against unauthorised entry to the building.

3.3 DEMOLITION

Explosives
Do not use explosives in the demolition process.

3.4 HAZARDOUS MATERIALS

General
General: Hazardous materials that have already been identified are set out in the Identified hazardous materials schedule.

Hazardous materials
General: Give notice immediately hazardous materials or conditions are found, including the following:
- Asbestos or material containing asbestos.
- Flammable or explosive liquids or gases.
- Toxic, infective or contaminated materials.
- Radiation or radioactive materials.
- Noxious or explosive chemicals.
- Tanks or other containers which have been used for storage of explosive, toxic, infective or contaminated substances.

3.5 COMPLETION

Notice of completion
Give at least 3 working days’ notice of completion of demolition so that adjacent structures may be inspected following completion of demolition.

Make good any damage arising out of demolition work. Obtain written acceptance from the owner of each adjoining property of completeness and standard of making good.

Temporary support
General: Clear away at completion of demolition.
PAVEMENT KERB, CHANNEL AND LINEMARKING

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Set out of kerbs and channels.
- Set out of linemarking prior to painting.

1.2 TOLERANCES

Kerbs and channels conform to the following:
- Absolute level tolerance: ± 10 mm.
- Maximum deviation from design alignment: 50 mm.
- Maximum deviation from a 3 m straightedge placed on horizontal, vertical, or sloping surfaces required to be straight: 5 mm.

Linemarking to conform to the following:
- The location of markings shall not vary from the locations shown on the drawings by more than 50 mm.

1.3 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.
- Absolute level tolerance: Maximum deviation from design levels.
- Relative level tolerance: Maximum deviation from a 3 m straightedge laid on the surface
- Channels and kerbs: Includes all forms of concrete gutters, dish drains, grated drains and mountable barrier kerbing.

2 PRODUCTS

2.1 MATERIALS

Concrete
Ready-mixed concrete shall comply with M-150 (1:2:4) for non-reinforced mass concrete and M-200 (1:1.5:3) for reinforced concrete and the requirements of these standards.

On site batch mixed concrete shall have characteristics and proportions of concrete ingredients which conform to those specified in M-150 (1:2:4) and M-200 (1:1.5:3).

Pavement marking paint
Provide samples of pavement marking paint and technical specifications for approval by the Engineer prior to use on site.

3 EXECUTION

3.1 LINEMARKING

Setting out
Set out the work to ensure that all markings are placed in accordance with the drawings.

Surface preparation
Clean dry surface: Pavement markings shall only be applied to clean dry surfaces. Clean the surface to ensure a satisfactory bond between the markings and wearing surface of the pavement.
Wet weather: Pavement marking shall not be carried out during wet weather or if rain is likely to fall during the process.

Provision for traffic: Provide for traffic while undertaking the work and protect the pavement markings until the material has hardened sufficiently so that traffic will not cause damage.

Mixing of paint: All paint shall be thoroughly mixed in its original container before use to produce a smooth uniform product.

**Application of paint**
Pavement markings shall be straight or with smooth, even curves where intended. All edges shall have a clean, sharp cut off. Any marking material applied beyond the defined edge of the marking shall be removed leaving a neat and smooth marking on the wearing surface of the pavement.

**Removal of pavement markings**
General: Remove pavement markings, no longer required, from the wearing surface of pavements without significant damage to the surface.

### 3.2 CHANNELS AND KERBS

**General**
Before placing any kerb and/or gutter, the foundation material shall be shaped and compacted to form a firm base. Where placed on pavement courses, the foundation shall be compacted to the requirements of the *Pavement base and subbase* worksection.

Kerb and/or gutters may be constructed in fixed forms, by extrusion or by slip forming in accordance with the drawings. The foundation, concrete quality, curing and testing details shall be in accordance with the *Concrete Paving* worksection.

**Tolerances**
The level at any point on the surface of the gutters shall be within ± 10 mm of design levels. When a straight edge 3 m long is laid on top of or along the face of the kerb or on the surface of gutters, the surface shall not vary more than 5 mm from the edge of the straight edge.

**Joints**
Contraction joints: Formed every 3 m of gutter length for a minimum of 50% of cross sectional area. The joint shall be tooled 20 mm in depth to form a neat groove of 5 mm minimum width.

Expansion joints: 15 mm in width for the full depth of the kerb and gutter. Joints shall be constructed at intervals not exceeding 15 m and where the gutter is attached to pits and retaining walls. Expansion joints shall consist of approved preformed jointing material.

Concrete pavement: Where kerbs and/or gutters are cast adjacent with a concrete pavement the same type of contraction, construction and expansion joints specified in the concrete base shall be continued across the kerb and/or gutter.

**Backfill**
Timing: After the new kerb and gutter has been constructed and not earlier than three days after placing, the spaces on both sides of the kerb and/or gutters shall be backfilled and reinstated in accordance with the drawings.

Material: Backfill material behind the kerb shall consist of granular material, free of organic material, clay and rock in excess of 50 mm diameter.

Compaction: Backfill material behind the kerb shall be compacted in layers not greater than 150 mm thick.
1 GENERAL

1.1 AIMS
Responsibilities
The aim of this worksection is to clear the site and put in place adequate environmental controls to allow the commencement of earthworks and/or building works.

1.2 SUBMISSIONS
Execution
Submit the methods and equipment proposed for the earthworks, including the following:
- Dewatering and groundwater control and disposal of surface water.
- Control of erosion and contamination of the site, surrounding areas and drainage systems.
- Dust control.
- Noise control.

2 EXECUTION

2.1 TREES
Work near trees
Keep the area within the dripline free of construction material and debris. Do not place bulk materials and harmful materials under or near trees. Do not place spoil from excavations against tree trunks. Prevent wind-blown materials such as cement from harming trees and plants.
Prevent damage to tree bark. Do not attach stays, guys and the like to trees.
If excavation is required near trees to be retained, give notice and obtain instructions. Open up excavations under tree canopies for as short a period as possible.
Use hand methods to locate, expose and cleanly remove the roots on the line of excavation. If it is necessary to excavate within the dripline, use hand methods such that root systems are preserved intact and undamaged.
Backfill to excavations around tree roots with backfill free from weed growth and harmful materials. Place the backfill layers, each of 300 mm maximum depth, compacted to a dry density similar to that of the original or surrounding soil. Do not backfill around tree trunks to a height greater than 300 mm above the original ground surface. Immediately after backfilling, thoroughly water the root zone surrounding the tree.
Water trees as necessary, including where roots are exposed at ambient temperature > 35°C.

2.2 EXISTING SERVICES
Marking
Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the earthworks operations including clearing, excavating and trenching.

Excavation
Do not excavate by machine within 1 m of existing underground services.

2.3 ENVIRONMENTAL PROTECTION
Dust protection
Provide dust-proof screens, bulkheads and covers to protect existing finishes and the immediate environment from dust and debris.

Dewatering
Keep groundworks free of water. Provide and maintain slopes and drains on excavations and embankments to ensure free drainage. Place construction, including fill, masonry, concrete and
services, on ground from which free water has been removed. Prevent water flow over freshly laid work.

2.4 SITE CLEARING

Extent
Clear only the following site areas:
- Areas to be occupied by works such as buildings, paving, excavation, regrading and landscaping.
- Other areas designated to be cleared.
Contractor’s site areas: If not included within the areas specified above, clear generally only to the extent necessary for the performance of the works.

Clearing and grubbing
Remove everything on or above the site surface, including rubbish, scrap, grass, vegetable matter and organic debris, scrub, trees, timber, stumps, boulders and rubble.
Remove tree stumps and roots over 75 mm diameter to a minimum depth of 500 mm below subgrade under buildings, embankments or paving, or 300 mm below finished surface in unpaved areas. Holes remaining after grubbing shall be backfilled with sand material to prevent ponding of water. The material shall be compacted to the relative density of the existing adjacent ground material.
Old works: Remove old works, including slabs, foundations, pavings, drains and manholes found on the surface unless identified on the drawings to remain intact.

Topsoil
All topsoil shall be stripped over the area on which construction or grading takes place. This topsoil shall be carefully stockpiled to be reused for landscaping on completion of the building operations or otherwise disposed of as directed.

2.5 DISPOSAL OF MATERIALS

Disposal
General: Remove cleared and grubbed material from the site.
1 GENERAL

1.1 INTERPRETATION

Definitions
For the purposes of this worksection the definitions given below apply.
- Bad ground: Ground unsuitable for the purposes of the works, including fill liable to subsidence,
ground containing cavities, faults or fissures, ground contaminated by harmful substances and
ground which is or becomes soft, wet or unstable.
- Line of influence: A line extending downward and outward from the bottom edge of a footing, slab or
pavement and defining the extent of foundation material having influence on the stability or support
of the footings, slab or pavement.

1.2 RECORDS OF MEASUREMENT

Excavation and backfilling
Do not commence backfilling or place permanent works in the excavation until the following have been
agreed and recorded:
- Depths of excavations related to the datum.
- Final plan dimensions of excavations.
Method of measurement: To be jointly agreed between the Engineer and Contractors Site Manager
unless otherwise agreed.

1.3 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Excavation completed to contract levels or founding material.
- Filling completed to contract levels.

1.4 TOLERANCES

Tolerances
Finish the surface to the required level, grade and shape within the following tolerances:
- Under building slabs and loadbearing elements: + 0, -40 mm.
- Pavement subgrades: + 0, - 60 mm.
- Other ground surfaces: 50 mm, provided the area will drain and matches adjacent construction
where required.

2 PRODUCTS

2.1 FILL MATERIALS

Fill material generally
Fill material is to be inorganic, non-perishable material.
Excluded materials:
- Organic soils.
- Materials contaminated through past site usage.
- Silts or silt-like materials.
- Fill containing wood, metal, plastic, boulders or other deleterious material.

Classifications for structural fill are based on the intended use of the fill, and defined as follows:
Class I structural fill - used as support for shallow foundations, paved areas, and slabs each with loadings of 3660 kgf/m² or more, for storage tanks, truck turnarounds, and base course and sub-base course for roadway pavements.

Class II structural fill - used as support for shallow foundations, paved areas, and slabs each with loadings of less than 3660 kgf/m² and for parking areas, backfill around foundations, for the construction of embankments, and for roadways pavement subgrades.

Class III non-structural fill - used in areas where installation of structures or equipment is not planned and in open areas where grading is only required to reach levels noted on the drawings.

**Re-use of material recovered from excavation**
Re-use excavated material elsewhere on site if approved by the Engineer.

## 3 EXECUTION

### 3.1 REMOVAL OF TOPSOIL

**General**
Remove topsoil to all areas to be cut, areas to be filled, areas to be occupied by structures, pavements, embankments and the like.

Maximum depth: 100 mm.

**Re-use of removed topsoil**
Re-use removed topsoil elsewhere on site as directed by the Engineer.

### 3.2 EXCAVATION

**Extent**
Excavate over the site to give correct levels for construction, pavements, filling and landscaping.

Excavate for footings, pits and shafts, to the required sizes and depths. Confirm that bearing capacity is adequate.

**Proof rolling**
Proof roll excavations for pavements, filling and non-spanning slabs on ground to determine the extent of any bad ground.

**Disposal of excess excavated material**
Remove excess excavated material from the site and dispose of legally.

### 3.3 BEARING SURFACES

**General**
Provide flat bearing surfaces for loadbearing elements including footings. Step to suit changes in levels. Make the steps to the appropriate courses if supporting masonry.

### 3.4 REINSTATEMENT OF EXCAVATION

**General**
Where excavation is deeper than the required depth, fill and consolidate to the correct depth.

### 3.5 SUPPORTING EXCAVATIONS

**Provision of supports**
Provide temporary supports to all excavations greater than 1.8m deep. Confirm type of supports and level of protection required with the Engineer.

**Removal of supports**
Remove temporary supports progressively as backfilling proceeds.

### 3.6 ADJACENT STRUCTURES

**Temporary supports**
Provide supports to adjacent structures where necessary, sufficient to prevent damage arising from the works. This applies to all structures where the line of influence is interfered with by the proposed excavation works.

Lateral supports: Provide lateral support using shoring.
Vertical supports: Provide vertical support where necessary using piling or underpinning or both.

**Permanent supports**
If permanent supports for adjacent structures are necessary and are not described, give notice and obtain instructions.

### 3.7 PREPARATION FOR FILLING

**General**
Prepare the ground surface before placing fill (including topsoil fill), ground slabs or load bearing elements. Shape to assist drainage. Compact the ground exposed after stripping or excavation.

### 3.8 PLACING FILL

**General**
Layers: Place fill in maximum 15cm horizontal layers across the fill area.
Mix: Place fill in a uniform mixture.
Protection: Protect the works from damage due to compaction operations. Where necessary, limit the size of compaction equipment or compact by hand. Commence compacting each layer at the structure and proceed away from it.

### 3.9 COMPACTION REQUIREMENTS FOR FILL AND SUBGRADE

**Density**
Compact the subgrade exposed by excavation to a minimum depth of 15cm. Compact each layer of fill to the required depth and density, as a systematic construction operation. Shape surfaces to provide drainage and prevent ponding.
Density of all layers of filling are to be approved by the Engineer before subsequent layers are placed.
Maximum rock and lump size in layer after compaction: 2/3 compacted layer thickness.

**Moisture content**
Adjust the moisture content of fill during compaction in order to achieve the required density. Do not allow subgrade or fill layers to dry out after compaction before placing subsequent layers of fill. Do not over water filling to greater than moisture content of adjoining undisturbed ground.
1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made at the following stages:
- Service trenches excavated before laying the service.
- Services laid in trenches and ready for backfilling.

2 EXECUTION

2.1 EXCAVATING

Excavation
Excavate for underground services, to required levels and grades. Generally make the trenches straight between inspection points and junctions, with vertical sides and uniform grades.

Trench widths
General: Keep trench widths to the minimum required for laying and bedding of the relevant service and construction of pits.

Trench depths
If excavation is necessary below the zone of influence of the underside of adjacent footings, give notice, and provide support for the footings as instructed.

Obstructions
Clear trenches of sharp projections. Cut back roots encountered in trenches to at least 600 mm clear of services. Remove other obstructions including stumps and boulders which may interfere with services or bedding.

Dewatering
Keep trenches free of water. Place bedding material, services and backfilling on firm ground free of surface water.

Excess excavation
If trench excavation exceeds the correct depth, reinstate to the correct depth and bearing value using compacted bedding material or sand stabilised with 1 part of cement to 20 parts of sand by weight.

2.2 BACKFILLING

General
Backfill service trenches as soon as possible after the service has been laid and bedded, if possible on the same working day. Place the backfill in layers maximum 150 mm thick and compact to approval of Engineer.

Backfill material
General fill with no stones greater than 25 mm occurring within 150 mm of the service, or other materials as required for particular services or locations.
Under roads and paved areas and within 4 m of building: Coarse sand, controlled low strength material or fine crushed rock.
In topsoil areas: Complete the backfilling with topsoil for at least the top 100 mm.

2.3 REINSTATEMENT OF SURFACES

General
Reinstate existing surfaces removed or disturbed by trench excavations to match existing and adjacent work.
1 GENERAL

1.1 INSPECTION
Notice

1.2 TESTS
Compaction control tests

Frequency of compaction control tests

2 PRODUCTS

2.1 BASE AND SUBBASE MATERIAL
General

Base and subbase compliance table

<table>
<thead>
<tr>
<th>Course</th>
<th>Source</th>
<th>Compliance requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>...</td>
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</table>

3 EXECUTION

3.1 SUBGRADE PREPARATION
General

3.2 SUBBASE AND BASE COMPACTION
General

Compaction requirements

...
Moisture content

3.3 PLACING BASE AND SUBBASE

General
1 GENERAL

1.1 INTERPRETATION

Definitions
For the purposes of this worksection the definitions given below apply.
- Absolute level tolerance: Maximum deviation from design levels.
- Relative level tolerance: Maximum deviation from a 3 m straight edge laid on the surface.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Concrete formwork, reinforcement and dowels in position.
- Commencement of concrete placing.

1.3 SUBMISSIONS

Products – proposals
Curing compounds: If it is proposed to use a liquid membrane-forming curing compound submit certified test results for water retention.
Curing by the covering sheet method: Submit details of the proposed covering material.
Repair materials: Submit proposals for epoxy resin/grout and elastomeric sealant.

1.4 TESTS

General
Perform tests of the type and frequency necessary to adequately control the materials and processes used in the construction of the works and in conformance with the Tests schedule.

Compliance assessment tests
Timing: Obtain materials samples at the time of delivery to the site.
Location: Sample from selected sample sites within designated uniform test lots, consisting of an area placed, or compacted or both in one day. Test lots must be uniform in terms of material properties and density.
Specimen type: A set of compression test specimens shall consist of four 200 x 200 x 200 mm cubes, each cube being one specimen.
The specimens within each set shall be tested at the following ages in conformance with the Tests schedule.
- One at 7 days for information.
- Two at 28 days. The 28 day strength shall be taken as the average of the two specimens. If one specimen in this test shows evidence of improper sampling, molding or testing, it shall be discarded. The remaining specimen shall be considered the test result. Should both specimens show the specified defects, the entire test shall be discarded.
- The fourth shall be retained as a spare to be tested as required.

Discharge slump tests
Carry out slump tests at approximately one quarter and three quarter points of the load during discharge.
Working slump: 100mm
Maximum slump: 125 mm. Note concrete with slump greater than this value will be rejected and removed from the site at the contractors cost.

Flexural strength assessment of concrete
Acceptance criterion: The average strength of any set of 3 consecutive project samples must not exceed the specified maximum value.
**Tests schedule**

<table>
<thead>
<tr>
<th>Samples</th>
<th>ASTM C172</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing</td>
<td>ASTM C31</td>
</tr>
<tr>
<td>Testing</td>
<td>ASTM C39</td>
</tr>
<tr>
<td>Slump Determination</td>
<td>ASTM C143</td>
</tr>
<tr>
<td>Air Content</td>
<td>ASTM C231 or C173</td>
</tr>
</tbody>
</table>

## 2 PRODUCTS

### 2.1 PRODUCTS

**Reinforcement**

All reinforcing shall be supported and wired together to prevent displacement by construction loads, or the placing of concrete, beyond the tolerances specified in ACI 301. Any tack or spot welding of reinforcement shall not be performed without approval from the Engineer.

Reinforcement shall be free of loose rust and of any other coating which may adversely affect the bond.

Splices in bar reinforcement shall be located and lapped as shown on the design drawings. Bars in lapped splices shall be in contact unless otherwise shown on the design drawings. Additional splices, if required, shall be made only at locations, and in a manner approved by the Engineer. Welded splices shall not be used. All lap splices in bar reinforcement shall be fully in compliance with ACI 318-02.

Welded wire fabric used in concrete paving shall have lapped splices made so that the overlap between the outermost cross wires of each fabric sheet is at least 50 mm.

Unless specifically indicated on the design drawings, splicing by means of proprietary mechanical splices shall not be used.

Concrete spacers, metal or plastic bar spacers i.e. chairs, shall be used for obtaining proper spacing of reinforcement from the bottom and sides of formwork.

**Dowels**

Provide each dowel in one piece, straight, cut accurately to length with ends square and free from burrs. Fix in locations as shown on the design drawings.

**Aggregate**

Aggregate size:
- For fixed form placement: < 40 mm.
- For slip form placement: To be a size compatible with the paving machine.

Washing: Wash aggregate as necessary or as directed to remove significant dust or achieve requirements for soluble salt content or concrete drying shrinkage.

**Cement**

Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.

Cement shall be free from any hardened lumps and foreign matter. It shall have a minimum of 90% of particles by weight passing the 75-micron sieve, an initial setting time in excess of 30 minutes and a final setting time of less than 7 hours.

Cement shall be stored in a waterproof shaded area. The cement stacks shall be placed at a minimum distance of 300mm from the walls. The damp proof floor shall be constructed by raising it minimum 300mm above the ground.

**Curing products**

Curing compounds: Obtain approval from the Engineer for all curing compounds prior to use.

Covering sheet materials: To be opaque polyethylene film, or burlap-polyethylene sheet, or equivalent material.

**Concrete**

Ready-mixed concrete shall comply with M-150 (1:2:4) for non-reinforced mass concrete and M-200 (1:1.5:3) for reinforced concrete and the requirements of these standards.
On site batch mixed concrete shall have characteristics and proportions of concrete ingredients which conform to those specified in M-150 (1:2:4) and M-200 (1:1.5:3).

Admixtures: Introduce in solution in a portion of the mixing water. Ensure a uniform distribution of the admixture in the batch within the mixing period.

Mixing time: Measure the mixing time after solid materials are in the mixer, provided that mixing water is introduced before a quarter of the mixing time has elapsed. Increase mixing time if necessary to obtain the required uniformity and consistence of concrete. Do not overmix such that additions of water are needed.

Transport: Transport and discharge the concrete without segregation.

Elapsed delivery time: Discharge truck mixed concrete within a time (t hours) determined as follows, where T is the temperature of the concrete in degrees Celsius:

\[ t = 2 - 0.05T. \]

### 3 EXECUTION

#### 3.1 PLACING

**Rate**
Place at a rate of at least 25 linear metres of pavement per hour.

**Tolerances**

Edges abutting gutters: Within ± 5 mm of the level of the actual gutter edge.

Rigid pavement surface:
- Absolute tolerance: ± 10 mm.
- Relative tolerance: 5 mm.

Concrete surface course: + unspecified, - 5 mm.

Joint locations (rigid pavement): 15 mm.

**Cold weather**

Subbase: Ensure that the subbase surface is free of frost.

Cold weather concreting shall be in accordance with the following:

a. The guidelines of ACI 306R shall be followed when the Forecasted Mean Daily Temperature drops below 4°C for three consecutive days. The minimum concrete temperature when delivered at the site shall be in accordance with Table I.

b. If water or aggregate is heated above 38°C, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38°C.

c. Concrete shall only be poured when the ambient temperature is rising.

d. All concrete shall be insulated from freezing for the greater of following:
   1. 3 days
   2. Until the concrete reaches an in-place compressive strength of 35 kg/cm²,

e. All materials shall be free from frost.

f. Accelerating admixtures shall not be used without approval from the Engineer.

Maintain the concrete at a temperature of at least 10°C for at least 24 hours after placing.

**Admixtures**

General: Do not add calcium chloride, salts, chemicals or other material to the mix to lower the freezing point of the concrete.

### TABLE I - MINIMUM COLD WEATHER TEMPERATURE

<table>
<thead>
<tr>
<th>AIR TEMPERATURE °C</th>
<th>MINIMUM CONCRETE TEMPERATURE °C</th>
</tr>
</thead>
</table>
CONCRETE PAVEMENT

<table>
<thead>
<tr>
<th></th>
<th>For Sections With Smallest Dimension Less Than 300 mm</th>
<th>For Sections With Smallest Dimension 300 mm Or Greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>-1 to 4</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>-18 to -1</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Below -18</td>
<td>21</td>
<td>18</td>
</tr>
</tbody>
</table>

**Hot weather**
Avoid premature stiffening of the mix and reduce water absorption and evaporation losses. If the temperature of the surrounding air is higher than 32°C:
- Mix, transport, place and compact the concrete as rapidly as possible, and cover with an impervious membrane or hessian kept wet until moist curing begins.
- Hold the concrete to a temperature < 32°C when placed.

Hot weather concreting shall be in accordance with the following:

a. Concrete temperatures shall be kept within desirable limits using methods recommended in ACI 305R.
b. For mass concrete, i.e., concrete sections having a minimum dimension of 750mm or greater, the maximum acceptable concrete temperature is 21°C at time of discharge.
c. For other concrete structures, the maximum acceptable concrete temperature is 32°C at time of discharge.
d. If ice is used as part of the mixing water, mixing should be continued until the ice is completely melted.
e. Retempering shall not increase the water content above that in the mix design.

**Placing in fixed forms**
Place concrete uniformly over the width of the slab or lane and so that the face is generally vertical and normal to the direction of placing. Hand spread concrete using shovels, not rakes.
Compact concrete using internal mechanical vibration of sufficient amplitude to produce noticeable vibrations at 300 mm radius. Insert vibrators into the concrete to the depth which will provide the best compaction, but not deeper than 50 mm above the surface of the subbase, and for a duration sufficient to produce satisfactory compaction, but not longer than 30 seconds in any one location.

**Slip form placing**
Spreading: Place the plastic concrete in a uniform layer over the width of the slab being placed. Do not damage the existing surface and edge of previously constructed concrete.
Vibration: Use suitable internal vibrators or surface type equipment with vibrating beam or beams of adequate power to fully compact the whole depth of the concrete.
Slab edges: Use supplementary immersion type vibrators next to slab edges if necessary to ensure that the sides of slabs present a uniform dense appearance free from honeycombing or areas deficient in fines over at least 95% of the surface.

**Finishing**
Immediately after placement and spreading and compaction of the plastic concrete, start finishing operations to achieve finish shown on the drawings.

**Curing**
Protect fresh concrete from premature drying and from excessively hot or cold temperatures. Maintain the concrete at a reasonably constant temperature with minimum moisture loss for the curing period.
- Temperature: Maintain the concrete at a temperature > 5°C for at least 7 days.
Curing compound method: Spray the entire surface including edges using a mechanical sprayer, at a uniform application rate of at least 0.35 L/m². Respray defective areas within 30 minutes. Respray within 3 hours after heavy rain. Apply as a continuous coating without visible breaks or pinholes.
Covering sheet method: Immediately after finishing operations cover concrete using damp hessian or cotton mats overlapped at least 150 mm and anchored against displacement by wind or other
interference. Keep the mats continuously damp until covered by the covering sheet material. Repair tears and the like immediately.
- Joint sawing: Sheet materials may be removed for the minimum distance and period to permit joint sawing, provided the concrete is kept moist by other means.

Moist curing method: Immediately after finishing operations keep the concrete surface continuously damp by spraying constantly with water, fog, or mist, using suitable spraying equipment. Minimum curing time: 7 days.

3.2 JOINTS

Joints
Construct expansion, contraction and construction joints straight and plumb. Make transverse joints normal to longitudinal joints. Extend transverse expansion and contraction joints continuously from edge to edge of the pavement through interconnected slabs.

Transverse construction joints: To be as follows:
- Planned location: Terminate each day’s placing operation at a transverse construction joint located to coincide with a planned contraction or expansion joint.
- Unplanned joints: If placement is interrupted for 30 minutes or longer, form a tied transverse construction joint within the middle third of the distance between planned joints but no closer than 1.5 m to the nearest planned joint. If necessary remove placed concrete back to the required location.

Expansion joints: Provide formed full depth joints around structures and features which project through, into or against the pavement, and elsewhere as required.

3.3 COMPLETION

Protection
Keep traffic, including construction plant, off the pavement entirely during curing, and thereafter permit access only to necessary constructional plant vehicles until the pavement is at least 14 days old.

Traffic on pavement
General: Give notice before opening the pavement to traffic before the work is completed. Provide adequate means of protection.
1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Base or subgrade before covering.
- Membrane or film underlay installed on the base.
- Completed formwork, and reinforcement, cores, fixings and embedded items fixed in place.
- Surfaces or elements to be concealed in the final work before covering.
- Commencement of concrete placing.

1.2 SUBMISSIONS

Products – proposals
Curing compounds: If it is proposed to use a liquid membrane-forming curing compound submit certified test results for water retention.
Curing by the covering sheet method: Submit details of the proposed covering material.
Repair materials: Submit proposals for epoxy resin/grout and elastomeric sealant.

1.3 TESTS

General
Perform tests of the type and frequency necessary to adequately control the materials and processes used in the construction of the works and in conformance with the Tests schedule.

Compliance assessment tests
Timing: Obtain materials samples at the time of delivery to the site.
Location: Sample from selected sample sites within designated uniform test lots, consisting of an area placed, or compacted or both in one day. Test lots must be uniform in terms of material properties and density.
Specimen type: A set of compression test specimens shall consist of four 200 x 200 x 200 mm cubes, each cube being one specimen.
The specimens within each set shall be tested at the following ages in conformance with the Tests schedule.
  - One at 7 days for information.
  - Two at 28 days. The 28 day strength shall be taken as the average of the two specimens. If one specimen in this test shows evidence of improper sampling, molding or testing, it shall be discarded. The remaining specimen shall be considered the test result. Should both specimens show the specified defects, the entire test shall be discarded.
  - The fourth shall be retained as a spare to be tested as required.

Discharge slump tests
Carry out slump tests at approximately one quarter and three quarter points of the load during discharge.
Working slump: 80mm
Maximum slump: 110 mm. Note concrete with slump greater than this value will be rejected and removed from the site at the contractors cost.

Flexural strength assessment of concrete
Acceptance criterion: The average strength of any set of 3 consecutive project samples must not exceed the specified maximum value.
Tests schedule

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2 EXECUTION

2.1 PRODUCTS

Reinforcement
All reinforcing shall be supported and wired together to prevent displacement by construction loads, or the placing of concrete, beyond the tolerances specified in ACI 301. Any tack or spot welding of reinforcement shall not be performed without approval from the Engineer.

Reinforcement shall be free of loose rust and of any other coating which may adversely affect the bond.

Splices in bar reinforcement shall be located and lapped as shown on the design drawings. Bars in lapped splices shall be in contact unless otherwise shown on the design drawings. Additional splices, if required, shall be made only at locations, and in a manner approved by the Engineer. Welded splices shall not be used. All lap splices in bar reinforcement shall be fully in compliance with ACI 318-02.

Welded wire fabric used in concrete paving shall have lapped splices made so that the overlap between the outermost cross wires of each fabric sheet is at least 50 mm.

Unless specifically indicated on the design drawings, splicing by means of proprietary mechanical splices shall not be used.

Concrete spacers, metal or plastic bar spacers i.e. chairs, shall be used for obtaining proper spacing of reinforcement from the bottom and sides of formwork.

Dowels
Provide each dowel in one piece, straight, cut accurately to length with ends square and free from burrs. Fix in locations as shown on the design drawings.

Formwork
Construct formwork with timber or steel elements to support the concrete for full duration of critical curing period. Construct in a durable manner with sufficient props and fixings to ensure that the formwork remains in position at all times.

Aggregate
Aggregate size:
- For fixed form placement: < 40 mm.
- For slip form placement: To be a size compatible with the paving machine.

Washing: Wash aggregate as necessary or as directed to remove significant dust or achieve requirements for soluble salt content or concrete drying shrinkage.

Cement
Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.

Cement shall be free from any hardened lumps and foreign matter. It shall have a minimum of 90% of particles by weight passing the 75-micron sieve, an initial setting time in excess of 30 minutes and a final setting time of less than 7 hours.

Cement shall be stored in a waterproof shaded area. The cement stacks shall be placed at a minimum distance of 300mm from the walls. The damp proof floor shall be constructed by raising it minimum 300mm above the ground.

Curing products
Curing compounds: Obtain approval from the Engineer for all curing compounds prior to use.

Covering sheet materials: To be opaque polyethylene film, or burlap-polyethylene sheet, or equivalent material.
Concrete

Ready-mixed concrete shall comply with M-150 (1:2:4) for non-reinforced mass concrete and M-200 (1:1.5:3) for reinforced concrete and the requirements of these standards.

On site batch mixed concrete shall have characteristics and proportions of concrete ingredients which conform to those specified in M-150 (1:2:4) and M-200 (1:1.5:3).

Admixtures: Introduce in solution in a portion of the mixing water. Ensure a uniform distribution of the admixture in the batch within the mixing period.

Mixing time: Measure the mixing time after solid materials are in the mixer, provided that mixing water is introduced before a quarter of the mixing time has elapsed. Increase mixing time if necessary to obtain the required uniformity and consistence of concrete. Do not overmix such that additions of water are needed.

Transport: Transport and discharge the concrete without segregation.

Elapsed delivery time: Discharge truck mixed concrete within a time (t hours) determined as follows, where T is the temperature of the concrete in degrees Celsius:

\[ t = 2 - 0.05T. \]

2.2 POLYMERIC FILM UNDERLAY

Location

Provide a vapour barrier under slabs on ground including integral ground beams and footings.

Installation

Lay over the base, lap joints at least 200 mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Patch or seal punctures or tears before pouring concrete. Cut back as required after concrete has gained strength and forms have been removed.

Base preparation

According to base type, as follows:
- Concrete working base: Remove projections above the plane surface, and loose material.
- Graded prepared subgrade: Blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay.

3 EXECUTION

3.1 PLACING- GENERAL

Cold weather

Subbase: Ensure that the subbase surface is free of frost.

Cold weather concreting shall be in accordance with the following:

a. The guidelines of ACI 306R shall be followed when the Forecasted Mean Daily Temperature drops below 4°C for three consecutive days. The minimum concrete temperature when delivered at the site shall be in accordance with Table I.

b. If water or aggregate is heated above 38°C, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38°C.

c. Concrete shall only be poured when the ambient temperature is rising.

d. All concrete shall be insulated from freezing for the greater of following:
   1. 3 days
   2. Until the concrete reaches an in-place compressive strength of 35 kg/cm²,

e. All materials shall be free from frost.

f. Accelerating admixtures shall not be used without approval from the Engineer.

Maintain the concrete at a temperature of at least 10°C for at least 24 hours after placing.

Admixtures

General: Do not add calcium chloride, salts, chemicals or other material to the mix to lower the freezing point of the concrete.
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**Hot weather**
Avoid premature stiffening of the mix and reduce water absorption and evaporation losses. If the temperature of the surrounding air is higher than 32°C:
- Mix, transport, place and compact the concrete as rapidly as possible, and cover with an impervious membrane or hessian kept wet until moist curing begins.
- Hold the concrete to a temperature < 32°C when placed.

Hot weather concreting shall be in accordance with the following:
- Concrete temperatures shall be kept within desirable limits using methods recommended in ACI 305R.
- For mass concrete, i.e., concrete sections having a minimum dimension of 750mm or greater, the maximum acceptable concrete temperature is 21°C at time of discharge.
- For other concrete structures, the maximum acceptable concrete temperature is 32°C at time of discharge.
- If ice is used as part of the mixing water, mixing should be continued until the ice is completely melted.
- Retempering shall not increase the water content above that in the mix design.

**Placing in fixed forms**
Place concrete uniformly over the width of the slab and so that the face is generally vertical and normal to the direction of placing. Hand spread concrete using shovels, not rakes.
Compact concrete using internal mechanical vibration of sufficient amplitude to produce noticeable vibrations at 300 mm radius. Insert vibrators into the concrete to the depth which will provide the best compaction, but not deeper than 50 mm above the surface of the subbase, and for a duration sufficient to produce satisfactory compaction, but not longer than 30 seconds in any one location.

**Elapsed delivery time**
General: Ensure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance with the **Elapsed delivery time table**. Do not discharge below 10°C or above 32°C.

**Elapsed delivery time table**

<table>
<thead>
<tr>
<th>Concrete temperature at time of discharge (°C)</th>
<th>Maximum elapsed time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 – 24</td>
<td>2.00</td>
</tr>
<tr>
<td>24 – 27</td>
<td>1.50</td>
</tr>
<tr>
<td>27 – 30</td>
<td>1.00</td>
</tr>
<tr>
<td>30 – 32</td>
<td>0.75</td>
</tr>
</tbody>
</table>

**Finishing**
Immediately after placement and spreading and compaction of the plastic concrete, start finishing operations to achieve finish shown on the drawings.
Curing
Protect fresh concrete from premature drying and from excessively hot or cold temperatures. Maintain the concrete at a reasonably constant temperature with minimum moisture loss for the curing period.
- Temperature: Maintain the concrete at a temperature > 5°C for at least 7 days.
Curing compound method: Spray the entire surface including edges using a mechanical sprayer, at a uniform application rate of at least 0.35 L/m². Respray defective areas within 30 minutes. Respray within 3 hours after heavy rain. Apply as a continuous coating without visible breaks or pinholes.
Covering sheet method: Immediately after finishing operations cover concrete using damp hessian or cotton mats overlapped at least 150 mm and anchored against displacement by wind or other interference. Keep the mats continuously damp until covered by the covering sheet material. Repair tears and the like immediately.
- Joint sawing: Sheet materials may be removed for the minimum distance and period to permit joint sawing, provided the concrete is kept moist by other means.
Moist curing method: Immediately after finishing operations keep the concrete surface continuously damp by spraying constantly with water, fog, or mist, using suitable spraying equipment. Minimum curing time: 7 days.

3.2 CORES, FIXINGS AND EMBEDDED ITEMS

Adjoining elements
For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. If required, provide for temporary support of adjoining elements during construction of the concrete.

Protection
Grease threads. Protect embedded items against damage.
Compatibility: Ensure inserts, fixings and embedded items are compatible with each other, with the reinforcement and with the concrete mix to be used.
Corrosion: If in external or exposed locations, galvanize anchor bolts and embedded fixings.

Structural integrity
Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, reposition but do not cut reinforcement, and maintain cover to reinforcement.

Tolerances
Maximum deviation from correct positions:
- Cores and embedded items generally: 10 mm.
- Other fixing bolts: 3 mm.

3.3 COMPACTION

Compaction
Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate to remove air bubbles and to fully compact the mix.
Vibrators: Do not allow vibrators to come into contact with partially hardened concrete, reinforcement or items including pipes and conduits embedded in concrete. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

Placing
Use placing methods which avoid segregation and loss of concrete, and which minimise plastic settlement. Maintain a generally vertical and plastic concrete edge at faces of a pour.
Layers: Place concrete in layers ≤ 300 mm thick, such that each succeeding layer is compacted before previous layer has taken initial set.

Rain
General: Do not expose concrete to rain before it has been placed and set.

Vertical elements
In vertical elements, limit the free fall of concrete to 1500 mm per 100 mm element thickness, up to a maximum free fall of 3000 mm, using enclosed vertical chutes or access hatches in forms.
3.4 CONSTRUCTION JOINTS

Location
Do not relocate or eliminate construction joints, or make construction joints not shown on the drawings. If emergency construction joints are made necessary by unforeseen interruptions to the concrete pour, submit a report on the action taken.

Joint preparation
Roughen and clean the hardened concrete joint surface. Remove loose or soft material, free water, and foreign matter. Dampen the surface just before placing the fresh concrete and coat with a neat cement slurry.

3.5 EXPANSION JOINTS

Joint filling
Joint filling: Fill with jointing materials. Finish visible jointing material neatly flush with adjoining surfaces.
Preparation: Before filling, dry and clean the joint surfaces, and prime.
Watertightness: Apply the jointing material so that joints subject to ingress of water are made watertight.
1 GENERAL

1.1 TOLERANCES

General
Unformed surfaces: Confirm conformance with the Tolerance classes table for the class of finish nominated using a straight edge placed anywhere on the surface in any direction.

Tolerances class table

<table>
<thead>
<tr>
<th>Class</th>
<th>Measurement</th>
<th>Maximum deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3 m straight edge</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>3 m straight edge</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>600 mm straight edge</td>
<td>6</td>
</tr>
</tbody>
</table>

2 PRODUCTS

2.1 MATERIALS

Surface hardeners, sealers and protectors
Supply: If required by the project documentation, provide proprietary products in accordance with the manufacturer’s written requirements.

3 EXECUTION

3.1 SURFACE MODIFIERS

General
Application: Apply to clean surfaces in accordance with the manufacturer’s requirements.

3.2 UNFORMED SURFACES

General
Screed and level slab surfaces to finished levels, to tolerance class C.

Finishing methods
Broom finish: After floating draw a broom or hessian belt across the surface to produce a coarse even-textured slip-resistant transverse-scored surface.

Machine floated finish: After screeding and when the concrete has stiffened sufficiently, work the slab 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 texture.

Scored or scratch finish: After screeding, give the surface a coarse scored texture using a stiff brush or rake drawn across the surface before final set.

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 finish free of trowel marks and defects, and uniform in texture and appearance, to tolerance class A.

Wood float finish: After screeding, machine produce the final finish using a wood float, to tolerance class B.
Polished finishes
Water blast: After steel trowelling, water blast the cured surface to provide texture or to form patterns without exposing the coarse aggregate using medium pressure water jets. Ensure that aggregate is not removed to a depth greater than 10mm.
Applied finish: To a steel trowel finished surface, apply a proprietary liquid or dry shake material in accordance with the manufacturer’s written requirements.
Burnished finish: Continue steel trowelling until the concrete surface attains a polished or glossy appearance.

Surface finishes
General: Provide surface finishes in conformance with the Integral finish schedule.

3.3 FORMED SURFACES

General
Provide formed concrete finishes in conformance with the Formed surface finishes schedule.
Damage: Do not damage concrete works through premature removal of formwork.

Curing
General: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.

Finishing methods
If exposed formed concrete elements are to have a finish other than off the form, provide details of proposed procedures. If not identified otherwise, all formed surfaces will be off form finish.
Exposed aggregate finish: Remove the vertical face forms while the concrete is green but set. Wet the surface and scrub using stiff fibre or wire brushes, using clean water freely, until the surface film of mortar is mechanically removed, and the aggregate uniformly exposed. Do not use acid etching. Rinse the surface with clean water.

- 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 a slurry, using hessian pads or sponge rubber floats. Remove surplus slurry and work until a uniform colour and texture are produced.

Surface repairs
Surface repair method: Before commencing repairs, submit proposals to the Engineer for approval.
1 GENERAL

1.1 DEFINITIONS

Definitions
For the purposes of this worksection the following definition applies:
- Precast units: Concrete elements manufactured in other than their final position including elements manufactured on site but excluding tilt-up panels.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Formwork dimensions and stability.
- Panel edge details and penetrations.
- Connection materials, reinforcement and inserts in place.

1.3 SUBMISSIONS

Subcontractors
Submit name and contact details of proposed manufacturer of precast concrete units.

Design
Veneered fabrication: If veneered fabrication is proposed submit proposals to the Engineer.
Contractor design: Provide verification by a professional engineer of compliance of the design with project documents.

Shop drawings
Submit shop drawings of precast units showing the proposed details for their design, manufacture, assembly, transport and installation, including the following:
- Project title and manufacturer's name.
- Shape or profile drawings (submit these before fabrication of moulds and tooling).
- Concrete mix and type of cement if special-class concrete.
- Veneer details, if applicable.
- Surface finish class and surface treatment, if applicable.
- Curing and protection methods.
- Marking plan.
- Equipment and methods for handling, transport and installation, including lifting inserts and pick-up points.
- Calculated maximum loadings on lifting and bracing inserts and attachments.
- Evidence of load capacity of lifting and bracing inserts and attachments in the form of test reports or calculations.

Lifting
Early lifting: If it is proposed to lift the units by their designated lifting points before 28 day strength has been achieved, submit evidence to demonstrate that the unit has adequate strength to carry its own weight without damage or residual cracking or deflection on removal of the lifting device.
Attachments for handling purposes: If it is proposed to locate lifting attachments, holes and other temporary fixings for handling purposes on visible faces of units, submit proposals.
Lifting units: If it is proposed to lift or support units at other than specified points, submit proposals.

1.4 PROTOTYPES

General
Provide prototypes in accordance with the Prototypes schedule.
Maintain prototypes on site, undamaged and protected from discolouration for comparison with manufactured precast units.

**Test panels**
Make separate test panels for surface finish, colour, or both, in conformance with the Prototypes schedule.

## 2 PRODUCTS

### 2.1 PRECAST UNITS

**Marking**
Identification: Identify units by marks which are as follows:
- Remain legible until after the unit has been fixed in place.
- Are not visible in the completed structure.
- Show the date of casting.
- Show the correct orientation of the unit.
- On other than units manufactured as a standard product, indicate the locations within the structure in accordance with the marking plan.

**Tolerances**
Fixings and embedded items in precast units: To be maximum of 5mm from design location unless agreed otherwise with the Engineer.

**Lifting devices**
Capacity: Design each lifting device for a working load at least 1.65 times the maximum calculated static load at that point and an ultimate load $\geq 4$ times the maximum static load.

**Attachments**
Sealing: Recess lifting attachments such as ferrules, or other types of cast-in fixings, and provide plugs for sealing.

### 2.2 VENEERED CONSTRUCTION

**General**
Use a method which ensures that delamination of the veneer will not occur. Obtain approval from the Engineer prior to construction commencing.

## 3 EXECUTION

### 3.1 HANDLING

**Precautions**
Lift or support units only at designated or other approved points. Use handling methods which do not overstress, warp or damage the units. Protect the units against staining, discolouration and other damage until they are installed in their final location.

**Attachments**
Remove temporary attachments after erection. Seal or otherwise make good residual recesses.

### 3.2 INSTALLATION

**General**
Fixing: Fix the units securely and accurately in their final positions.

Ancillaries: Provide components and materials, including fasteners, braces, shims, jointing strips, sealant, flashings, grout and mortar, necessary for the installation of the units.
LIGHT STEELWORK

1 GENERAL

1.1 INSPECTION

Notice
Give notice so that inspection may be made of steel framing erected before lining or cladding.

1.2 SUBMISSIONS

Design
The Contractor is to confirm that all proposed member sizes are available for the project in accordance with the drawings and BOQ. If selected sizes are not available, seek alternatives and obtain approval from the Engineer.

2 EXECUTION

2.1 CONSTRUCTION GENERALLY

Fabrication
Length: Cut members accurately to length so that they fit firmly against abutting members.
Service holes: Form holes by drilling or punching if needed.
- Bushes: Provide plastic bushes or grommets to site cut holes.
- Swarf: Remove swarf and other debris from cold-formed steel framing immediately.
Site work: Do not fabricate on site where welded connections are required.

Fastening
Select from the following:
- Bolting.
- Self-drilling, self-tapping screws.
- Blind rivets.

Welding
Burning: Avoid procedures that result in greater than localised “burning” of the sheets or framing members. Protect other adjoining materials from damage during welding activities.
Other workers: Protect other workers on site from welding flash, sparks and other potential injuries during welding activities.

Prefabricated frames
Protect frames from damage or distortion during storage, transport and erection.

Unseasoned timber
Do not fix in contact with framing without fully painting the timber and/or the steel to avoid future rusting of the steel.

Earthing
Permanent earthing: Required.
Temporary earthing: Provide temporary earthing during erection until the permanent earthing is installed.

Protection
Coatings which have been damaged by welding or other causes shall be restored. Thoroughly clean affected areas to base metal and coat with zinc rich organic primer.

2.2 TRUSSES

Fabrication
Factory assemble trusses and transport to site where possible. Obtain approval from the Engineer if it is required to fabricate trusses on site.
Marking
Permanently mark each truss to show:
- Manufacturer.
- Tag or number.
- Location.
- Support points.

Installation
Fix to support structures, plumb to within H/200, where H is the height at the apex.

2.3 COMPLETION

Cleaning
On completion of framing remove debris from any gaps between members.
1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Surfaces after preparation prior to application of first coating.
- Coating after application of final coat.

1.2 SAMPLES

Painting and coating colour
Submit a sample of the finished product for each different coating system.
Size of each sample: 200 x 200 mm.

2 PRODUCTS

2.1 GENERAL

General
All protective coatings must be handled, stored, mixed and applied strictly in accordance with the manufacturer's instructions and Product Data Sheets.

3 EXECUTION

3.1 PROTECTION

Surroundings
Provide protection of the surroundings to the coating works and ensure that no abrasive, overspray or paint waste debris is released either to air, ground or to any watercourse. Repair or clean damage as appropriate.

Contamination
Ensure protection of sensitive items during surface preparation and coating works. Do not permit surface preparation debris to contaminate coated surfaces which are not yet dry, nor cause damage to any other services or equipment.

Stacking and handling
Do not stack, handle or transport coated items until the coating has sufficiently cured so as to resist handling actions.

Stack and handle all steelwork using fabric slings or padded chains, used in a manner that ensures that no damage is caused to the coating system. Adopt soft packaging, carpet strips or other deformable materials between all steel items. Do not permit steel to steel contact in any situation.

Water ponding: Stack coated items so that water ponding does not or cannot occur whilst the items are in storage, transport or "laydown".

Repair of coating damage
If damage occurs repair so as to ensure that the full corrosion protection ability of the system is reinstated.

3.2 SURFACE PREPARATION

General
Coatings shall be applied only to properly prepared and cleaned surfaces.
Surface preparation
Ensure all surfaces are free from oil, grease, dirt, bird droppings or any other contaminants, particularly soluble contaminants.
Surface defects: Remove or correct other surface defects, including cracks, laminations, deep pitting, undercutting, weld spatter, slag, burrs, fins and sharp edges.
Remove all weld spatter by grinding or chipping.

Priming
Prime coat all surfaces with zinc rich primer on the same day as the completion of surface preparation works. In every case, the specified surface preparation standard, in both cleanliness and profile, shall be evident at the time that the primer coating is applied.

3.3 COATING APPLICATION

General
Apply the coatings in accordance with the Paint Finishes Schedule.

Final surface preparation or coating application
Limits: If the following climatic/substrate conditions are present do not apply coating:
- The ambient air temperature is below 5°C or above 40°C.
- The substrate temperature is below 10°C or above 35°C.
- The surface to be coated is wet or damp.
Defects: Apply materials so as to produce an even coating free from film defects.
Detail: Stripe coat all welds, bolt holes, sharp edges and difficult to spray areas by brushing in with the prime coat and intermediate coat material prior to the full coating application.

Subsequent coats
Ensure that before any subsequent coating layer is applied, the surface condition of the preceding coat is complete and correct in all respects, including its cleanliness and freedom from defects.
Correct any defects before the next coating layer is applied.
1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Timber framing after erection before lining or cladding.
- Roof framing and connection to wall and ceiling structures.

1.2 SUBMISSIONS

Design
The Contractor is to confirm that all proposed member sizes are available for the project in accordance
with the drawings and BOQ. If selected sizes are not available, seek alternatives and obtain approval
from the Engineer.

2 PRODUCTS

2.1 TIMBER

Timber grades
Structural timbers:
- Appearance grade if exposed to view in the finished work:
  Use best quality timber free from twists, knots, splits and other visual or physical defects.
- Structural grade if concealed in the building:
  Lower quality timber with some visual defects acceptable but with minimal physical defects.

2.2 SHEET PRODUCTS

Structural plywood panels
All structural plywood panels used for construction purposes are to be approved by the Engineer. Refer
to drawings and BOQ for details of locations and sizes. All structural plywood is to be tested before use
to the satisfaction of the Engineer to ensure that it will be suitable for the proposed use.
Use branded or certified plywood products where possible.

Hardboard or fibreboard panels
All hardboard or fibreboard panels used for construction purposes are to be approved by the Engineer.
Refer to drawings and BOQ for details of locations and sizes. All material is to be tested before use to
the satisfaction of the Engineer to ensure that it will be suitable for the proposed use.
Use branded or certified products where possible.

2.3 COMPONENTS

Steel post bases
Minimum dimensions:
- Stirrup: 75 mm wide x 6 mm thick.
- Dowel: 20 mm diameter heavy tube.
Location: To timber posts supported off concrete slabs or footings.
Finish: Galvanize after fabrication.

Fasteners
Material:
Use best quality steel bolts, washers and nuts for bolted connections. Washers to be used both sides
of timber to avoid crushing of the timber at the connection point.
Use best quality screws to avoid damage to screw heads during tightening process.
Use best quality bright steel nails for internal work protected from the weather and galvanised nails for external fixings exposed to the weather. Lightweight allow bolts and screws will not be permitted. Installation: Pre drill holes in hardwood timber to avoid splitting the timber. Do not split or otherwise damage the timber or fastener by hammering bolts or screws into the timber.

### EXECUTION

#### 3.1 GENERAL

**Protection from weather**
General: Provide temporary protection for members until permanent covering is in place.

#### 3.2 FLOOR FRAMING

**Bearers and joists**
Levelling: Level bearers and joists by packing for the full width of the member.
Joints: Locate joints only over supports:
- Minimum bearing of bearers: 50 mm.
- Minimum bearing of joists: 30 mm.
Fixing: Secure bearers and joists to supports to provide restraint against lateral movement.
Joist restraint: If joist timber is unseasoned, the span ≥ 3000 mm, provide solid blocking between each joist in rows at 1800 mm centres and at the ends of the joists over the supports.
Members: Provide bearers and joists where shown on the drawings and in the BOQ.

**Flooring**
Provide flooring of structural plywood where shown on the drawings and in the BOQ.

#### 3.3 ROOF AND CEILING FRAMING

**Wall plates**
Fix timber wall plates to top of masonry walls with either straps or bolts, or provide fixings cast into the ring beam as required.

**Ceiling framing**
Construct timber framed ceilings where shown on drawings with battens fixed to underside of trusses or ceiling joists as required.

**Additional support**
Provide a frame member behind every joint in fibre cement sheeting or plywood lining to ensure that the lining is fully supported.

**Roof cladding boards**
Provide roof cladding boards minimum of 20mm thick to full extent of roof structure to support flat metal sheet roofing where shown on drawings. Securely fix to structure and ensure that the top surface is as smooth as possible to avoid damage to the roof sheeting.

#### 3.4 TRUSSES

**Installation**
Support: Support trusses on bottom chord at two points only, unless designed for additional support. Plumb: Within H/200, where H is the height.
Vertical movement: Over internal walls provide at least 10 mm vertical clearance and use bracing methods which allow for vertical movements.
Construction: Construct trusses strictly in accordance with the drawings. If variations are proposed due to construction fabrication or installation issues, obtain approval from the Engineer before changing the design.

#### 3.5 COMPLETION

**Tightening**
Tighten bolts, screws and other fixings so that joints and anchorages are secure at all times.
Clean up
Remove all shavings, discarded chips and pieces of timber from the structure during construction and clean up all working areas prior to Completion.
1 GENERAL

1.1 INTERPRETATIONS

Definitions
For the purposes of this worksection the definitions given below apply.
- Substrates: The surfaces on which membrane systems are laid.
- Bitumen: A viscous material comprising complex hydrocarbons which is soluble in carbon disulphide, softens when it is heated, is waterproof and has good powers of adhesion. It is produced as a refined by-product of oil.
- Bond breakers: Layers which prevent membranes from bonding to the backgrounds.
- Membranes: Impervious barriers to liquid water which may be:
  - Liquid applied: Membranes applied in liquid or gel form and air cured to form a seamless film.
  - Sheet applied: Membranes applied in sheet form with joints lapped and bonded.
- Membrane systems: Combinations of membranes, flashings, drainage and accessories which form waterproof barriers and which may be:
  - Loose-laid.
  - Bonded to backgrounds fully or partially.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made as follows:
- Background preparation completed.
- Before membranes are finished, covered up or concealed.

2 PRODUCTS

2.1 MEMBRANES

Membrane systems
To be proprietary membrane systems where possible having certification from an international testing organisation.

Internal roof outlets for membrane roof
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.

3 EXECUTION

3.1 PREPARATION

General
Prepare backgrounds as follows:
- Fill all cracks in backgrounds wider than 1.5 mm with a filler compatible with the membrane system.
- Fill voids and hollows in concrete backgrounds with a concrete mix not stronger than the background.
- Remove excessive projections.
- Remove deleterious and loose material.
- Leave the surface free of contaminates, clean and dust free.
Moisture content
Concrete backgrounds: Cure for > 21 days.

Falls
Verify that falls in backgrounds are > 1:100.

Joints and fillets
Internal corners: Provide 45° fillets.
External corners: Round or arris edges.
Movement control joints: Prepare all background joints to suit the membrane system.

Priming
If required, prime the backgrounds with compatible primers to ensure adhesion of membrane systems.

3.2 APPLICATION

Protection
Protect membrane from damage during installation.

Drains
Prevent moisture from tracking under the membranes at drainage locations.
Drains and cages: Provide grates or cages, to prevent blockage from debris.
Overflows: Turn the membranes into the overflow to prevent moisture from tracking behind the membrane.

Sheet joints
Bituminous sheet membranes:
- Side laps > 50 mm.
- End laps > 100 mm.

Synthetic rubber membranes:
- Factory-vulcanized laps > 40 mm.
- Field side laps > 50 mm for side laps.
- Field end-laps > 100 mm for end laps.

Curing of liquid applied systems
To the manufacturers’ instructions.

Movement control joints
Locate over movement control joints in the substructure.
Fillets and bond breakers: Provide of sufficient dimension to allow the membrane to accommodate the movement.
Bonded membranes: Carry movement joints in the substrate through the surface finish.

Membrane terminations
Edge protection: Provide upturns above the maximum water level expected from the exposure conditions of rainfall intensity and wind.
- Minimum height of 200mm for all upturns above membrane level unless noted otherwise on the drawings.
- Anchoring: Secure sheet membranes along the top edge.
- Edge protection: Protect edges of the membrane.
- Waterproofing above terminations: Waterproof the structure above the termination to prevent moisture entry behind the membrane using cappings, waterproof membranes or waterproof coatings.

Membrane vertical penetrations
- Pipes, ducts, and vents: Provide separate sleeves for all pipes, ducts, and vents and have them fixed to the substrate. Minimum height of 200mm for all sleeves above membrane level unless noted otherwise on the drawings.
Overlaying finishes on membranes
Compatibility: If a membrane is to be overlayed with another system such as tiles, pavers, ballast, insulation, soil, and the like, provide an overlaying system that is compatible with and not cause damage to the membrane.

Ensure that no damage is caused to the membrane during the laying of the overlay material. If any damage occurs immediately stop work and repair the damage before proceeding with the overlay process.

Bonded or partially bonded systems: If the topping or bedding mortar requires to be bonded to the membrane, provide sufficient movement joints in the topping or bedding mortar to reduce the movement over the membrane.
1 GENERAL

1.1 TOLERANCES

Responsibilities
Fabricate and install joinery items. Items to be undamaged, plumb, level, straight and free of distortion and to the Tolerances table.

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plumb and level</td>
<td>2 mm in 800 mm</td>
</tr>
<tr>
<td>Offsets in flush adjoining surfaces</td>
<td>&lt; 1 mm</td>
</tr>
<tr>
<td>Alignment of adjoining doors</td>
<td>&lt; 1.5 mm</td>
</tr>
</tbody>
</table>

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Shop fabricated or assembled items ready for delivery to the site.
- Site erected assemblies on completion of erection.

1.3 SUBMISSIONS

Samples
Submit samples to the Sample table for approval by the Engineer.

<table>
<thead>
<tr>
<th>Description</th>
<th>No. of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each type of board to be used complete with finish and edge stripping</td>
<td>2</td>
</tr>
<tr>
<td>Typical item of hardware indicating each finish</td>
<td>2</td>
</tr>
<tr>
<td>Stone benchtop indicating range of colours</td>
<td>2</td>
</tr>
<tr>
<td>Timber balustrade section</td>
<td>1</td>
</tr>
<tr>
<td>The finish to all stainless steel items</td>
<td>2</td>
</tr>
<tr>
<td>Complete timber bench cupboard door, including hardware</td>
<td>1</td>
</tr>
<tr>
<td>Complete drawer front, including hardware</td>
<td>1</td>
</tr>
</tbody>
</table>

2 PRODUCTS

2.1 JOINERY MATERIALS AND COMPONENTS

Joinery timber
Best quality Russian joinery timber to approval of the Engineer.

Plywood
Best quality imported plywood to approval of the Engineer.

Decorative overlays
Timber veneer or laminate to approval of the Engineer.

Thickness (minimum):
- For horizontal surfaces fixed to a continuous background: 1.2 mm minimum.
- For vertical surfaces fixed to a continuous background: 0.8 mm.
- For edge strips: 0.8 mm.

**Stone facings**
Provide stone slabs to benchtops within the visual range of the approved samples.

**Timber veneers**
Provide veneers falling within the visual range of the approved samples.

### 2.2 JOINERY ITEMS

**General**
Provide materials noted on drawings as follows:
- Joinery components and their location, indicative construction details, trims, materials, dimensions and thicknesses, and finishes shall be as detailed.
- All dimensions noted on drawings shall be confirmed on site before construction of the joinery.
- Finishes selections and hardware are noted in the *Joinery Fixtures schedule*.

### 2.3 KITCHEN ASSEMBLIES

**Plinths**
Material: Construct from exterior grade general purpose plywood unless already in place as a concrete plinth.
Thickness: 16 mm.
Fabrication: Form up with front and back members and full height cross members at not more than 900 mm centres.
Finish: Decorative laminated sheet or ceramic/stone tile finish.
Installation: Fix to floor and secure to wall to provide level platform for carcasses.

**Carcasses**
Material: Select from the following:
- Melamine overlaid high moisture resistant particleboard.
- Approved solid timber sections.
Thickness: 16 mm minimum.
Joints: Select from the following:
- Proprietary mechanical connections.
- Screws and glue.
Shelves: Support on battens or fix directly into grooves in side walls of joinery units.
Finish: Decorative laminated sheet or solid timber finish.
Fasteners: Conceal with finish.
Installation: Secure to walls at not more than 600 mm centres.

**Drawer fronts and doors**
Material: Refer to the drawings for specific details of joinery or select from the following:
- Melamine overlaid high moisture resistant particleboard.
- Approved solid timber sections with or without inset glass panels.
- Metal grille or sheet metal panels fixed over timber frames
Thickness: 16 mm minimum.
Maximum door size: 2400 mm high, 900 mm wide, 1.5 m² on face.
Finish: Decorative laminated sheet, solid timber finish or paint.

**Drawer backs, sides and bottoms**
Material: Select from the following:
- Melamine overlaid high moisture resistant particleboard.
- Approved solid timber sections.
Thickness: 12 mm minimum.
Finish: Decorative laminated sheet or solid timber finish.

**Laminated benchtops**
Material: High moisture resistant particleboard.
Benchtop thickness: 33 mm.
Finish: Decorative laminated sheet.
Exposed edges: Extend laminate over shaped nosing, finishing > 50 mm back on underside or provide solid timber edge trim.
Installation: Fix to carcass at least twice per 600 mm length of benchtop.
Joint sealing: Clamp with proprietary mechanical connectors to ensure high quality connection between benchtop sections. Ensure joints in benchtops are clear of sinks to avoid water damage to joint.

**Stone or concrete benchtops**

Material:
- Thickness is to be minimum of 40mm unless noted otherwise on the drawings.
- Concrete benchtops may have a polished finish or be covered with ceramic tiles.

**Splashback:**

Material is identical to benchtop unless noted otherwise in Fixtures Schedule.
- Thickness is to be 16mm for high moisture resistant particleboard with laminate finish.
- Thickness is to be 20mm minimum for stone.
- Thickness is to be 40mm minimum for concrete. Alternatively use ceramic tile splashback for concrete benchtops.
- Waterproof silicone sealant is to be used as a continuous seal between the benchtop and splashback.

**Drawer and door hardware**

Hinges, drawer runners, door handles and locks are to be to the approval of the Engineer.

### 2.4 TIMBER BALUSTRADES

Provide materials for the approval of the Engineer before installation. Ensure all dimensions are checked on site before construction starts. Refer to BOQ and drawings for extent of work.

### 3 EXECUTION

#### 3.1 JOINERY

**General**

Joints: Provide materials in single lengths whenever possible. If joints are necessary make them over supports.
Framing: Frame and trim where necessary for openings, including those required by other trades.

**Accessories and trim**

Provide accessories and trim necessary to complete the installation.

**Fasteners**

Visibility: Do not provide visible fixings except in the following locations:
- Inside cupboards and drawer units.
- Inside open units.

Visible fixings: Where fastenings are unavoidable on visible joinery faces, sink the heads below the surface and fill the sinking flush with a material compatible with the surface finish. In surfaces which are to have clear or tinted timber finish provide matching wood plugs showing face (not end) grain. In surfaces which are to have laminate finish provide proprietary screws and caps finished to match.

Fixings: Screws with washers into timber or steel framing, or masonry anchors to brickwork.

**Adhesives**

Provide adhesives to transmit the loads imposed and to ensure the rigidity of the assembly, without causing discolouration of finished surfaces.

**Finishing**

Edge strips: Finish exposed edges of sheets with edge strips which match sheet faces or use solid timber trims as noted on the drawings.

Matching: For surfaces which are to have clear or tinted finish, arrange adjacent timber pieces to match the grain and colour.
Hygiene requirements: To all food handling areas and voids at the backs of units to all areas, seal all carcass junctions with walls and floors, and to cable entries, with silicone sealant for vermin proofing. Apply water resistant sealants around all plumbing fixtures and ensure the sealants are fit for purpose.

3.2 DELIVERY AND STORAGE

General
Deliver joinery units to site in unbroken wrapping or containers so that its moisture content is not adversely affected. Do not store in areas of wet plaster. Keep storage to a minimum by delivering items only when required for installation.

Examine joinery units for completeness and repair defects before installing in place.

Background
Clean all background surfaces that will be permanently concealed behind joinery before installing in place.

3.3 TIMBER BALUSTRADES

General
Provide a balustrade to the stair and landing, consisting of posts, handrail, infill panels, and associated mouldings as noted in the BOQ and drawings.

3.4 COMPLETION

Cleaning
Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.

General: Remove all dust, marks and rubbish from all surfaces and internal spaces. Clean and polish all surfaces such as solid timber, anodised or painted metals, glass, stone, concrete, ceramic tiles and laminates.

Refer to the Joinery Fixtures Schedule for locations, type and finishes of joinery items.
1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Shop fabricated or assembled items ready for delivery to the site.
- Site erected assemblies on completion of erection.

1.2 SUBMISSIONS

Samples
Submit samples to the Sample table for approval by the Engineer.

Sample table

<table>
<thead>
<tr>
<th>Description</th>
<th>No. of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each type of metal item to be purchased</td>
<td>2</td>
</tr>
<tr>
<td>Typical joints of welded or fabricated items</td>
<td>2</td>
</tr>
<tr>
<td>Finished sample of each type of painted or anodised metalwork indicating range within colour specified and finish</td>
<td>2</td>
</tr>
<tr>
<td>The finish to all stainless steel items</td>
<td>2</td>
</tr>
</tbody>
</table>

Manufacturer’s data: Submit manufacturer’s published product data and details for purchased items. Stainless steel: For each batch of stainless steel supplied to the works, submit the certificate of compliance specified for the applicable standard.

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Metals
Performance: Provide metals suited to their required function, finish and method of fabrication, in sections of strength and stiffness adequate for their purpose.

Rivets
Use blind rivets where available in the required metal.

Masonry anchors
Proprietary types comprising screws or bolts in self-expanding sockets.

Masonry plugs
Screws in purpose-made resilient plastic sockets or fixed to timber plugs built into the wall surface.

3 EXECUTION

3.1 CONSTRUCTION GENERALLY

Metals
Provide metals so that they transmit the loads imposed and ensure the rigidity of the assembly without causing deflection or distortion of finished surfaces.

Fasteners
Materials: Provide fasteners in materials of mechanical strength and corrosion resistance at least equal to that of the lowest resistant metal joined.
To copper and copper alloys: Provide copper or copper-alloy fixing devices only.
To aluminium and aluminium alloys: Provide aluminium alloy or stainless steel fixing devices only.
To stainless steel: Provide appropriate stainless steel materials only.

**Fabrication**
Workshop: Fabricate and pre-assemble items in the workshop wherever practicable.
Edges and surfaces: Keep clean, neat and free from burrs and indentations. Remove sharp edges without excessive radiusing.
Tube bends: Form bends in tube without visibly deforming the cross section.
Colour finished work: Match colours of sheets, extrusions and heads of fasteners.
Thermal movement: Accommodate thermal movement in joints and fastenings.

**Fabrication tolerances**
Structural work generally: ± 2 mm from design dimensions.

**Joints**
Fit joints to an accuracy appropriate to the class of work. Finish visible joints made by welding, brazing or soldering using grinding, buffing or other methods appropriate to the class of work, before further treatment.
Self-finished metals: Free of surface colour variations, after jointing.
Joints: Fit accurately to a hairline where feasible.

**Marking**
Provide suitable and sufficient marks or other means for identifying each member of site-erected assemblies, and for their correct setting out, location, erection and connection.

**Splicing**
Provide structural members in single lengths where possible. Obtain approval of the Engineer for locations of joints where splices in metalwork cannot be avoided.

### 3.2 WELDING AND BRAZING

**General**
Quality: Provide finished welds which are free of surface and internal cracks, slag inclusion, and porosity.

**Brazing**
General: Ensure brazed joints have sufficient lap to provide a mechanically sound joint. Do not used butt joints relying on the filler metal fillet only.

### 3.3 STAINLESS STEEL FABRICATION

**Welding stainless steel**
All tube, angle or thick plate material is to be welded unless noted otherwise on the drawings. Ensure that welds do not discolour the final surface finish in the welding process.

**Riveting**
Riveting may be used only to join stainless steel sheet or strip less than 1 mm thick. Drill (not punch) the rivet hole, and drive the rivet cold. On completion, clean and passivate the riveted assembly.

**Soldering**
Do not solder stainless steel.

### 3.4 METAL FIXTURES

**General**
Provide metal fixtures where noted on drawings and in the Metal Fixtures Schedule as follows:
- Components such as toilet roll holders, towel rails, soap dishes and their location, indicative construction details, trims, materials, dimensions and thicknesses, and finishes shall be as detailed or described in the schedule.
- All dimensions noted on drawings shall be confirmed on site.

### 3.5 PIPE HANDRAILS, STAIRS, LADDERS AND BALUSTRADES

**Assembly**
Material: Refer to drawings and BOQ for details of member sizes and assembly of components.
Fabrication
Method: Welding.
Joints: Produce smooth unbroken surfaces at joints. Make end-to-end joints over an internal sleeve.
Bends: Make changes of direction in rails by evenly curved pipe bends.
Free ends: Seal the free ends of pipes with fabricated or purpose-made end caps.

Fixing to structure
Provide fabricated predrilled or purpose-made brackets or post bases, and attach the pipework to the building structure with fixings, including bolts into masonry anchors, and coach screws or bolts into timber, of metal compatible with the pipework.

Galvanizing
If possible, complete fabrication before galvanizing; otherwise apply a zinc-rich primer to affected joint surfaces.

Painting
If possible, complete fabrication before painting; otherwise apply paint to affected joint surfaces after fixing on site. Make good all damaged painted surfaces before completion of the building works.

3.6 CORNER GUARDS AND VEHICLE GUARDS

Corner Guards
Where corners of the structure are required to be protected from mechanical damage, provide metal corner guards as follows and as identified on the drawings or in the BOQ:
- Consisting of angle sections or sections fabricated from metal sheet bent to the radius or angle of the corner.
- Fitting close to adjoining surface finishes.
- Solidly grouted up at the back to eliminate voids.
- Securely fixed by a method which does not cause distortion in the guard surface, and consists of either concealed built in lugs, or flush countersunk head fixings into masonry anchors.
- Paint finish in accordance with the Finishes Schedule.

Vehicle Guards
Where external features such as lamp posts, fire hose reels or pedestrian walkways are required to be protected from vehicle damage, provide metal guards as follows and as identified on the drawings and in the BOQ:
- Consisting of steel pipe posts set in deep concrete pads with welded end caps or bent to form a rail and two posts.
- Steel barrier rails securely bolted to the posts.
- Heavy duty protection posts will be large diameter steel pipe posts filled with concrete.
- Paint finish in accordance with the Finishes Schedule.

3.7 WATER STORAGE TANKS AND STANDS

Water Tanks
Fabricate metal water storage tanks to sizes shown on drawings and as identified in the BOQ. Allow for all reinforcement of tank walls, floors, and around fixtures projecting from the tank.
Bolt together prefabricated plastic or metal water storage tanks to sizes shown on drawings and as identified in the BOQ.
Fabricate metal tank stands for the water storage tanks as identified on the drawings and in the BOQ.
Refer to the Metal Fixtures Schedule for details.

3.8 COMPLETION

Maintenance manual
General: Submit manufacturer’s published recommendations for service use.

Cleaning
Temporary coatings: On or before completion of the works, or before joining up to other surfaces, remove all traces of temporary coatings used as a means of protection.
1 GENERAL

1.1 INTERPRETATION

Abbreviations
For the purpose to this worksection the abbreviations given below apply.
- CRF: Cement render – finish.
- CRM: Cement render – medium.
- CRS: Cement render – stronger.
- CRW: Cement render – weaker.
- LF: Lime felting render- weaker.
- GPF: Gypsum plaster – finish.

1.2 INSPECTION

Notice
Give sufficient notice so inspection may be made of the following:
- Backgrounds immediately before applying base coats.
- Finish treatments before decoration.

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Accessories
Beads: To be metal proprietary sections manufactured to be fixed to backgrounds and/or embedded in
the plaster to form and protect plaster edges and junctions.

Aggregates
Sand: To be fine, sharp, well-graded sand with a low clay content and free from efflorescing salts.

Bonding products
To be proprietary products manufactured for bonding cement-based plaster to solid backgrounds.

Cement
Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved
standard for normal Portland cement.

Colouring products
To be proprietary products manufactured for colouring cement plaster.
Integral pigment proportion: 5% by mass of cement.

Curing products
To be proprietary products manufactured for use with the plaster system.

Gypsum plaster
To be a proprietary product containing calcium sulfate hemihydrate with additives to modify setting.

Lime
Confirm source of Lime with Engineer to ensure highest quality Lime is used in the mortar. Protect
from damage on site and store minimum 300mm above ground in waterproof storage facility.

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.
Mixes
Select a mix ratio to suit the application in conformity to the Mixes table.
Measurement: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.
Plaster mixing: Machine mix for greater than 3 minutes and less than 6 minutes.
Strength of successive coats: Ensure successive coats are no richer in binder than the coat to which they are applied.

Mixes table

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Application</th>
<th>Upper and lower limits of proportions by volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Gypsum</td>
</tr>
<tr>
<td>Cement render coats</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>in:</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>- Single or multi-coat systems with integral finishing treatments</td>
<td>Dense and smooth concrete and masonry Thrown finishing treatments Tiled finishes Gypsum finishes Cement finishes</td>
<td>-</td>
</tr>
<tr>
<td>- Base coats in multi-coat systems with cement or gypsum finishes</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>CRM</td>
<td>Clay or concrete masonry</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>CRW</td>
<td>Lightweight concrete masonry and other weak backgrounds</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>CRM</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Cement finish coats</td>
<td>Cement render base coats</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>LF</td>
<td>Cement render base coats</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Lime felting finish coats</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>GPF</td>
<td>Cement render base coats</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Movement control joint products
To be proprietary products manufactured for use with the plastering system and to accommodate the anticipated movement of the backgrounds and/or the plaster.

Water
To be clean and free from any deleterious matter.

Refer to the Plastering Construction Schedule for details of plastering and locations.

3 EXECUTION

3.1 PREPARATION

Substrates
Ensure substrates have:
- Any deposit or finish which may impair adhesion of plaster cleaned off.
- If solid or continuous, excessive projections hacked off and voids and hollows filled with plaster stronger than the first coat and not weaker than the background.
Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not plaster backgrounds showing surface moisture.
Dense concrete: If not sufficiently rough to provide a mechanical key, roughen by scratching or hacking to remove 2 mm of the surface and expose the aggregate then apply a bonding treatment.
Painted surfaces: Remove paint and hack the surface at close intervals.
Untrue substrates: If the substrate is not sufficiently true to ensure conformity with the thickness limits for the plaster system or has excessively uneven suction resulting from variations in the composition of the background, apply additional coats.
Beads
Location: Fix beads as follows:
- Angle beads: At all external corners.
- Drip beads: At all lower terminations of external plaster.
- Mechanical fixing to background: at 300 mm centres.
- Movement control beads: At all movement control joints.
- Stop beads: At all terminations of plaster and junctions with other materials or plaster systems.

Bonding treatment
If bonding treatment is required, throw a wet mix onto the background as follows:
- Cement plaster: 1 part cement to 2 parts sand.
- Gypsum plaster: 1 part gypsum to 2 parts sand.
Curing: Keep continuously moist for 5 days and allow to dry before applying plaster coats.
Thickness: From greater than 3mm but less than 6 mm.

Embedded items
If there are water pipes and other embedded items, sheath them to permit thermal movement. Ensure embedded items will have a suitable level of corrosion resistance prior to embedment.

3.2 APPLICATION
Plastering
General: Provide plaster finishes as follows:
- Resistant to impacts expected in use.
- Free of irregularities.
- Consistent in texture and finish.
- Firmly bonded to substrates for the expected life of the application.
- As a suitable substrate for the nominated final finish.
Base coats: Scratch-comb each base coat in two directions when it has stiffened.

Finishing treatments
Plain:
- Bag: To be a finish mainly free from sand by rubbing the finish coat with a Hessian pad when it has set firm.
- Carborundum stone: To be a smooth finish free from sand by, rubbing the finish coat with a fine carborundum stone when it has set hard.
- Steel trowel: To be a smooth dense surface by steel trowelling which is not glass-like and is free from shrinkage cracks and crazing.
- Wood or plastic float: To be an even surface by wood or plastic floating the finish coat on application.

Incidental work
Return plaster into reveals, beads, sills, recesses and niches. Plaster faces, ends, and soffits of projections in the background, such as string courses, sills, and other wall features. Trim around openings. Plaster exposed inside of built-in cupboards.

Joining up
If joining up is required, ensure joints will not be visible in the finished work after decoration.

Movement control joints
Provide movement control joints in the finish to coincide with movement joints in the background. Ensure that the joint in the background is not bridged during plastering.
- Depth: Extend the joint right through the plaster and reinforcement to the background.
- Width: 3 mm, or the same width as the background joint, whichever is greater.
Damp-proof courses: Do not continue plaster across damp-proof courses.
V-joints: Provide V-joints, cut right through the plaster to the background, at the following locations:
- Abutments with metal door frames.
- Abutments with other finishes.
- Junctions between different backgrounds.
Plaster thickness
Conform to the Plaster thickness table.

Plaster thickness table

<table>
<thead>
<tr>
<th>Plaster</th>
<th>Application</th>
<th>Upper limit of thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Single coat systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Base coat(s)</td>
</tr>
<tr>
<td>Cement render base coats and cement or gypsum finish coats</td>
<td>On smooth dense concrete</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>On clay and concrete brickwork and other backgrounds</td>
<td>15</td>
</tr>
</tbody>
</table>

Temperature
If the ambient temperature is less than 10°C or more than 30°C ensure that the temperature of mixes, backgrounds and reinforcement are, at the time of application, greater than 5°C or less than 35°C.

3.3 TOLERANCES

General
Conform to the Tolerances table.

Tolerances table

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria: Permitted deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features(^\d): Verticality in 2000 mm</td>
<td>3</td>
</tr>
<tr>
<td>Features: Horizontality in 2000 mm</td>
<td>3</td>
</tr>
<tr>
<td>Soffits: Horizontality in 2000 mm</td>
<td>5</td>
</tr>
<tr>
<td>Walls: Verticality in 2000 mm</td>
<td>5</td>
</tr>
<tr>
<td>Walls: Flatness(^\d) in 2000 mm</td>
<td>4</td>
</tr>
</tbody>
</table>

\(^\d\) Features: Conspicuous horizontal or vertical lines including external corners, parapets, reveals, heads, sills, movement control joints and mouldings.

\(^\d\) Flatness: Measured under a straightedge laid in any direction on a plane surface.

3.4 COMPLETION

Curing
General: Prevent premature or uneven drying out and protect from the sun and wind.
Keeping moist: If a proprietary curing agent is not used, keep the plaster moist as follows:
- Base coats and single coat systems: Keep continuously moist for 2 days and allow to dry for 5 days before applying further plaster coats.
- Finish coats: Keep continuously moist for 2 days.
1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the substrate immediately before application of paint finishes.

1.2 SUBMISSIONS

Clear finish coated samples
Submit pieces of timber or timber veneer matching the timber to be used in the works, prepared and coated in accordance with the paint system.

Opaque coated samples
Provide approx 600x600mm samples on representative substrates of each paint system showing surface preparation, colour, gloss level and texture.

2 PRODUCTS

2.1 PAINTS

Combinations
Do not combine paints from different manufacturers in a paint system.
Clear timber finish systems: Provide only the combinations of putty, stain and sealer recommended by the manufacturer of the top coats.

Delivery
Deliver paints to the site in the manufacturer's labelled and unopened containers.

Tinting
Provide only products which are colour tinted by the manufacturer or supplier.

Putty
Non-timber substrates: Oil-based or polymeric based.
Timber finishes: Lacquer or water based only.

3 EXECUTION

3.1 PREPARATION

Order of work
Other trades: Before painting, complete the work of other trades as far as practicable within the area to be painted, except for installation of fittings and laying flooring materials.
Clear finishes: Complete clear timber finishes before commencing opaque paint finishes in the same area.

Protection
Fixtures: Remove door furniture, switch plates, light fittings and other fixtures before starting to paint, and refix in position undamaged on completion of the installation.
Adjacent surfaces: Protect adjacent finished surfaces liable to damage from painting operations.

“Wet paint” warning
Place notices conspicuously and do not remove them until paint is dry.

Restoration
Clean off marks, paint spots and stains progressively and restore damaged surfaces to their original condition. Touch up damaged decorative paintwork or misses only with the paint batch used in the original application.
Substrate preparation
Prepare substrates to receive the painting systems.
Cleaning: Clean down the substrate surface. Do not cause undue damage to the substrate or damage to, or contamination of, the surroundings.
Filling: Fill cracks and holes with fillers, sealants, putties or grouting cements as appropriate for the finishing system and substrate, and sand smooth.
Clear finish: Provide filler tinted to match the substrate.
Clear timber finish systems: Prepare the surface so that its attributes will show through the clear finish without blemishes, by methods which may involve the following:
- Removal of discolourations, including staining by oil, grease and nailheads.
- Puttying.

3.2 PAINTING
Provide coating systems to substrates as follows and as scheduled:
- Consistent in colour, gloss level, texture and thickness.
- Free of runs, sags, blisters, or other discontinuities.
- Fully adhered.
- Resistant to expected impacts in use.
- Resistant to environmental degradation within the manufacturer’s stated life span.

Drying
Ensure that the moisture content of the substrate is at or below the recommended maximum level for the type of paint and the substrate material.

Paint application
Apply the first coat immediately after substrate preparation and before contamination of the substrate can occur. Apply subsequent coats after the manufacturer’s recommended drying period has elapsed.

Priming before fixing
Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:
- Timber door and window frames.
- Bottoms of external doors.
- Associated trims and glazing beads.

Spraying
If the paint application is by spraying, use conventional or airless equipment which does the following:
- Satisfactorily atomises the paint being applied.
- Does not require the paint to be thinned beyond the maximum amount recommended by the manufacturer.
- Does not introduce oil, water or other contaminants into the applied paint.

Sanding
Clear finishes: Sand the sealer using the finest possible abrasive and avoid cutting through the colour. Take special care with round surfaces and edges.

Repair of galvanizing
For galvanized surfaces which have been subsequently welded, prime the affected area.

4 SELECTIONS

4.1 PAINT SYSTEMS

Paint system description
Choose from the following paint systems and substrates and paint in accordance with manufacturers recommendations and Painting Schedules:

Paint Systems:
Flat water based: Interior
Low gloss water based: Interior
Flat or low gloss water based: Exterior
Semi-gloss water based: Interior
Semi-gloss water based: Exterior
Gloss water based: Interior
Gloss water based: Exterior
Semi-gloss, oil based: Interior
Full gloss, oil based: Interior
Full gloss, oil based: Exterior
Texture finish, water based: Interior
Texture finish, water based: Exterior
Varnish clear: Interior
Varnish tinted: Interior
Opaque timber finish, water based: Exterior
Paving paint - Semi gloss oil based
Roofing paint, oil based
Low flame spread specialised coating

**Substrate Types:**
Existing paintwork (oil based)
Existing paintwork (water based)
Concrete
Cement render
Fibre cement
Brickwork
Set plaster
Glass reinforced gypsum plaster
Plasterboard (paper faced)
Iron and steel
Aluminium
Metallic-coated steel
Oil-based air-drying primed metal
Organic or inorganic zinc primed metal
Timber
Particleboard
UPVC

**Number of coats**
Unless specified as one coat or two coat systems, each paint system consists of at least 3 coats.

**Colour selection**
As nominated in the Painting schedules.
1 GENERAL

1.1 AIMS
Responsibilities
Provide electrical systems in conformance with the Schedules.

Qualification
Use only persons appropriately experienced and qualified to undertake the electrical design and construction work on the systems documented.

Performance
Carry out verification tests and measurements to show compliance with the specification.

1.2 Inspection

Notice
Give sufficient notice so that inspection may be made of the following:
- Underground electrical services conduits prior to concealment.
- Above ground electrical services conduits in walls prior to concealment.
- Switchboards prior to installation.

2 EXECUTION

2.1 GENERAL

General
Arrangement: Arrange services so that services running together are parallel with each other and with adjacent building elements.

Installation: Install equipment and services plumb, fix securely and organise reticulated services neatly. Allow for movement in both structure and services.

Lifting: Provide heavy items of equipment with permanent fixtures for lifting as recommended by the manufacturer.

Suspended ground floors: Keep all parts of services under suspended ground floors > 150 mm clear of the ground surface. Make sure services do not impede access.

Samples
Samples: Provide samples of all accessories and light fittings for the approval of the Engineer prior to use in the project.

Installation of accessories
General: Install accessories in conformance with the Installation of accessories table.

Flush mounting: Provide flush mounted accessories except in plant rooms.

Mounting heights: To on-site direction

Restricted location: Do not install wall boxes across junctions of wall finishes.

Surface mounting: Proprietary mounting blocks.

### Installation of accessories table

<table>
<thead>
<tr>
<th>Wall construction</th>
<th>Installation and concealed cabling facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rendered brickwork partition</td>
<td>Flush wall box with conduit chased into wall</td>
</tr>
<tr>
<td>Double sided face brick partition</td>
<td>Vertically mounted flush wall box with conduit concealed in cut bricks</td>
</tr>
<tr>
<td>Concrete wall or slab</td>
<td>Flush wall box or flush mounted outlet with thermoplastic insulated cables in conduit integral with slab. Do not chase into concrete walls without</td>
</tr>
</tbody>
</table>
Installation of ceiling mounted appliances
Connections: Provide flush mounted outlets on the ceiling next to support brackets.
Fixing: Provide support brackets fixed through ceiling to the building structure. Brace appliances that have excessive bending moments, are heavy or vibrate, to prevent horizontal movement.

2.2 LOW VOLTAGE POWER SYSTEMS

General
Provide a complete operational low voltage power system, comprising the following and to the Schedules:
- Supply from mains power
- Metering.
- Consumers mains and switchboard.
- Submains and sub boards.
- Final subcircuits.

Submissions
Technical data: Submit documentation to fully describe the proposed installation. As a minimum provide:
- Submain cable routes and support or enclosure method.
- Switchboard cupboard layouts including risers.

Accessories
Provide the following and to the Schedules:
- General power outlets.
- Isolating switches.
- Three phase outlets.
- Ceiling mounted sweep fans
- Wall, window or roof mounted exhaust fans
- Other equipment as identified in the Schedule

Wiring systems
Selection: Provide wiring systems appropriate to the installation conditions and the function of the load.

Power cables
Copper cable generally, multi-stranded except for MIMS.
Minimum size:
- Lighting subcircuits: 1.5 mm$^2$.
- Power subcircuits: 2.5 mm$^2$.
- Submains: 6 mm$^2$.
Voltage drop: Install final subcircuit cables within the voltage drop parameters dictated by the route length and load.

Dummy load tests
Where electrical tests are required and the actual load is not available, provide a dummy load equal to at least 75% of the design load.

2.3 SWITCHBOARDS

General
Provide proprietary switchboards to the following and to the Schedules:
- Main switchboard.
- Distribution boards.
**Statutory authority's equipment**
Refer to local supply authority service rules to determine their requirements. Install equipment supplied by the statutory authority, and provide wiring to complete the installation.

**Cable entries**
Single core cables rated > 300 A: Arrange to minimise eddy currents.

**Construction**
Fixing: Before making interpanel connections, fix assemblies and metering equipment enclosures into position, level and plumb.

Cable entries: Neatly adapt one or more cable entry plates, if fitted, to accept incoming cable enclosure. Provide the minimum number of entry plates to leave spare capacity for future cable entries. Do not run cables into the top of weatherproof assemblies.

Single core cables rated > 300 A: Pass separately through non-ferrous gland plates. Do not provide metal saddles.

Cable enclosures: Continue cable enclosures to or into assemblies and fit cable entry plates so that the IP rating of the assembly and the fire rating of the cable are maintained.

Cable supports: Support or tie mains and submains cables within 200 mm of terminations.

### 2.4 SWITCHBOARD COMPONENTS

**Switch-isolator and combination fuse-switch units**
Rated current: To suit unit installed in enclosure.
Rated fault capacity: Provide units selected for short-circuit making capacity that is at least the fault level at assembly incoming terminals.
Breaking capacity: At least the rated full load current.
Rated duty: Uninterrupted in non-ventilated enclosure.
Operation: Independent manual operation including positive ‘ON/OFF’ indicator.
Locking: Provide for padlocking in the ‘OFF’ position.
Handles: Removable only when switch is in open position.
Fuse links: Isolated when switch contacts are open.

**Moulded case and miniature circuit breakers**
Moulded case breakers to International Standards.
Miniature circuit breakers to International Standards
Fault capacity > 10 kA: circuit breakers to approval of Engineer
Fault capacity < 10 kA, current rating < 100 A: Miniature overcurrent circuit breakers
Mounting: Mount circuit breakers so that the ‘ON/OFF’ and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.
Clip tray chassis: For miniature overcurrent circuit breakers provide clip tray assemblies capable of accepting single, double, or triple circuit breakers, and related busbars. Provide moulded clip-on pole fillers for unused portions.

**Residual current devices**
Integral type: Incorporate earth leakage in circuit breaker protection operation.
Maximum tripping current: 30 mA.

**Fuses with enclosed fuse links**
Standards: To International Standards
Fault level: Provide fuses suitable for the fault level at the assembly, and which discriminate with other protective equipment.
Let-through energy and peak cut-off current: To suit protected equipment.
Fuse-holders: Mount fuse-holders so that fuse carriers may be withdrawn directly towards the operator and away from live parts. Provide fixed insulation which shrouds live metal when the fuse carrier is withdrawn.
Barriers: Provide barriers on both sides of each fuse link, preventing inadvertent electrical contact between phases by the insertion of screwdriver.
Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier. If necessary for safe removal and insertion of the fuse carrier, provide extraction handles. Mount on clips within the spares cabinet.

Identification: Clearly indicate manufacturer or distributor.

**Contactors**

- **Standard:** To International Standards.
- **Rated operational current:** Full load current of the load controlled.
- **Minimum rating:** 16 A.
- **Mounting:** Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.
- **Interconnection:** Do not connect contactors in series or parallel to achieve ratings.

### 2.5 LIGHTING

**General**

Provide a complete operational lighting system, tested and commissioned.

- **Proprietary equipment:** Provide only proprietary lights, fittings and accessories.
- **Modifications and refurbishing:** Carry out to the original manufacturer’s standards.

**Lamps**

- **Lamps:** Provide all lights complete with lamps and accessories.
- **Verify operation:** Install lamps in all lights and verify correct operation before completion.
- **Low voltage lamps:** Provide lamps strictly in accordance with the light manufacturer's recommendation.
- **Dichroic lamps:** Provide dichroic lamps with integral reflector which match the design specification.

**Lighting control system**

Provide the following and to the Schedules:
- Lighting switches.
- Dimmers.
- Automatic control systems.
- External light fittings.
- Internal light fittings.

**Documentation:** Provide complete technical and operational documentation for the lighting control system where installed.

**Installation**

- **Supports:** Mount lights on proprietary supports by means of battens, trims or packing material to suit location.

**Completion**

- Verify the operation of all lights.

### 2.6 EMERGENCY EVACUATION LIGHTING

**General**

Provide a complete operational emergency evacuation lighting system, tested and commissioned to International Standards.

**Single-point system lights**

- **Visual indicator lights:** Provide a red indicator, readily visible when the light is in its operating location, which indicates that the battery is being charged.
- **Inverter system:** Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.
- **Local test switches:** Provide a momentary action test switch, accessible from below the ceiling, on each fitting to temporarily disconnect the mains supply and connect the battery to the lamp.
- **Common test switches:** Provide a common test switch on the distribution board which disconnects main supply to the lights and tests for discharge performance, after testing, this switch must automatically revert to normal operating mode.
Batteries
Type: Lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously at least 2 hours during completion tests and 1.5 hours during subsequent tests.
Battery life: At least 3 years when operating under normal conditions at an ambient temperature of 25°C and subjected to charging and discharging at 6 monthly intervals.
Marking: Indelibly mark each battery with its date of manufacture.

Power supply to single-point systems
Provide an unswitched active supply to each fitting and exit sign, originating from the test switch control panel.

2.7 TELECOMMUNICATION CABLES

General
Provide a complete operational telecommunications cabling system, tested and commissioned to International Standards. Provide accommodation for telecommunications cabling infrastructure complying with relevant clearance requirements from power cable distribution systems.

Include the following and to the Schedules:
- Building distributor.
- Backbone cabling.
- Floor distributors.
- Consolidation points.
- Equipment racks and patch cords.
- Horizontal cabling.
- Telecommunications outlets.
- Fly leads.

Equipment racks
Type: 19 inch rack.
Free standing racks: Provide adjustable feet.

Modular connector patch panels
Terminations: Terminate directly to the modular connector.
Patch cords: Terminate cord ends with appropriate registered jacks.

Optical fibre termination panels
Break out trays: Provide fibre optic cable break out trays at each group of fibre optic cable terminations.
Loom cables: Neatly loom cables and lay stripped cables into the break out tray.
Secure cables: Ensure that cables are secured by the sheath and that there is no stress on the fibre optic cores.

Patch cords
Provide terminated patch cords for 60% of the total incoming and outgoing ports used.

Records
Record book: Provide a record book at each cross connect.
Records in pencil: Complete the records in pencil for each termination and jumper, providing origin and destination and type of service.
Location: Secure log books in each distribution frame records holder.

Cable separation
Low voltage cables: Separate telecommunications cables not enclosed in conduits or ducts from low voltage services by at least 150 mm.
Electromagnetic interference (EMI): Provide clearance to minimise the effect of EMI where communications cables are installed parallel and adjacent to power cables carrying loads in excess of 200 A.

Installation
Crossover: Install cables neatly and without crossovers between cables.
Loom size: Loom cables into groups not exceeding 50 cables, and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.
Telecommunications outlets
Outlets: Provide RJ45 8 way modular jacks except where documented otherwise.
Pinouts: The pinouts vary with the application. Determine required pinouts before making cable terminations.

Fly leads
Provide minimum 2000mm long fly leads to 50% of the outlets installed.

Earthing system
Communication earth system (CES): Provide a communications earth terminal (CET) associated with the local protective earth (PE) system adjacent to each electrical distribution board.

2.8 AUTOMATIC FIRE DETECTION

General
Provide a fully operational system, tested and commissioned in accordance with International Standards.

Base station monitoring system connection
Connection: Connect the installation to the fire alarm monitoring base station via telecommunication carrier lines where identified in the Schedule.

Installation wiring
Conductor size: > 1.5 mm² TPI 220 V rated, with red and white insulation.
Sheathing: Red.

Fire indicator panels
Provide metal cubicle-type enclosures to locations identified on drawings.

Detectors
Provide the following detector types as indicated on the drawings:
- Point type heat detectors.
- Duct sampling units.
- Integral heat detector/alarm units.
- Point type smoke detectors.
- Integral smoke detector/alarm units.

Self-indicating detectors
Provide a light emitting diode mounted in a clearly visible position, which illuminates whenever detector operation causes an alarm condition to register on the fire indicator panel. Provide self-indicating devices which, if faulty, will not render the detector inoperative under fire conditions.
Mounting positions of light emitting diodes:
- Visible detectors: On the outside of the detector or its base.
- Detectors concealed above ceilings: On the underside of the ceiling immediately below the detector.
- Detectors in other concealed spaces: On a visible panel close to the entry to the concealed space housing the detector.

Installation
Install detectors so they can be easily inspected and tested in situ, and readily withdrawn for service.

Control facilities
Provide ancillary control device circuits and connections for automatically controlling and releasing magnetic door holders to operate the relevant fire doors under fire alarm conditions.

Fire fan control and indication panels
Provide fire detection and alarm signals for the fire fan control panel to be incorporated by mechanical services.

2.9 ACCESS CONTROL

General
Provide a complete operational access control system, tested and commissioned in accordance with International Standards as applicable.
Processors or panels
Capacity: Provide separate entry/exit control modules for each designated door.
Users: Program the system to match the number of authorised users with unique access codes.
Time zones: At least 3 per day, with provision for weekends and public holidays.

Door control devices
Provide electric strikes, electric locks, drop bolts, or similar devices to suit door construction and hardware.
Fail-safe: Connect door control devices in a fail-safe mode to permit exit in the event of power failure.
Authorised products: Provide equipment approved for use by the Engineer.
Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

Activation
Provide keypads, card readers or other activation devices, and locate next to entry points.
External: Provide weatherproof (IP56) hoods or housings for external units.
Mounting height: 1200 mm from floor level.

Vehicle control
Vehicle access control: Provide a vehicle access control system combining connection to vehicular doors and boom gates, and interconnection to the main access control system.
Exit Loop detection: Provide a buried loop detection system adjacent to the exit point to activate boom gates or vehicular doors on approach by a vehicle. Connect so that doors or gates close after a pre-set time.
Interlock: Provide a photo electric beam safety interlock.
Interlock function: To prevent door or gate from closing until the vehicle has cleared the exit point.
Push-buttons and readers: Where practicable, provide direct wall mounting for push-buttons or readers; otherwise provide a mounting bollard and extension arm.
Mounting height: 1000 mm from floor level.
Reed switches: Provide heavy duty reed switches on both sides of vehicle doors, which generate a door closed indication at the control panel.

Intercom
Base station: Provide an intercom base station at each external entry point, interconnected with the individual local stations. Include speakers and microphones.
Construction: Wall mounted flush stainless steel panel.
Weatherproofing: IP56.
Dial: Digital push-button type.
Schedule: Provide a weatherproof (IP56) schedule holder and card identifying individual local stations. Locate next to the intercom panel.
Local station: Provide wall mounted intercom local stations, interconnected with the base stations and external entry points.
Type: Surface mounted, removable handset type.
Operation: Provide an audible tone device to indicate that the individual station is being called, and a press-to-talk switch so that the local station can communicate with the base station only when the switch is held down.
Door control: Provide integral momentary action door release switches to operate the door release or opening mechanisms at each external entry point.

2.10 LABELLING

General
Provide labels including control and circuit equipment ratings, functional units, notices for operational and maintenance personnel, incoming and outgoing circuit rating, sizes and origin of supply and kW ratings of motor starters.

Identifying labels
Provide labels fixed to access panels, doors, covers and escutcheon panels and internal equipment, indicating the relevant information and componentry.
Single-line diagrams
Custom-built assemblies: Provide single-line diagrams. Format: Non-fading print, at least A3 size, showing the situation as installed. Mounting: Enclose in a folder and fix close to assembly.

Marking cables
Identify the origin of all wiring by means of legible indelible marking. Identification labels: Provide durable labels fitted to each core and sheath, permanently marked with numbers, letters or both to suit the connection diagrams.

Telecommunications cabling
Label telecommunications cables, cross connects and outlets.

Labels: Label cables to indicate the origin and destination of the cable. Label outlets to show the origin of the cross connect, the workstation or outlet number, and the port designation.

Location marking
Accurately mark the location of underground cables with route markers consisting of a marker plate set flush in a concrete base. Location: Place markers at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m. Concrete bases: 200 mm diameter x 200 mm deep, minimum. Direction marking: Show the direction of the cable run by means of direction arrows on the marker plate. Indicate distance to the next marker. Plates: Brass, minimum size 75 x 75 x 1 mm thick. Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws. Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

Labelling – minimum lettering heights
Main assembly designation: 25 mm. Distribution assembly designations: 15 mm. Small proprietary distribution boards: 10 mm. Main switches: 10 mm. Outgoing functional units: 8 mm. Identifying labels (on outside of cabinet rear covers): 4 mm. Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder. Other labels including equipment labels within cabinets: 3 mm.

Label colours
Generally black lettering on white background except as follows:
- Main switch and caution labels: Red lettering on white background.
- Danger, warning labels: White lettering on red background.

Fixing
General: Fix labels securely. Fixing methods: Use screws and double-sided adhesive. Fixed in extruded aluminium sections attached to panels with rivets or countersunk screws. Permanent fixing: Fix labels permanently in place.

Refer to drawings, BOQ and Schedules for details and locations of all fixtures, fittings and cabling.
1 GENERAL

1.1 AIMS

General
Provide proprietary packaged stand-by generating set(s) incorporating the following:
- Engine cooling system.
- Combustion air system.
- Exhaust system.
- Liquid fuel system.
- Acoustic enclosure.
- Control system.
- Connection to low voltage power system.

1.2 INTERPRETATIONS

Definitions
Net continuous rated output (or prime rating): Net continuous electrical output available at alternator terminals, not including the electrical power consumed by the generating set’s dependent and essential auxiliaries.
Net short-time rated output (or stand-by rating): Net electrical output available from the generating set for 1 hour in every 12 hours at net continuous rated output, not including electrical power consumed by the generating set’s dependent and essential auxiliaries.
Start response time: Total elapsed time from receipt of start signal to final connection to load.

1.3 INSPECTION

Notice
Give sufficient notice so that inspection may be made of each completed generating set and associated systems before connection to electrical services.

1.4 SUBMISSIONS

Technical data
Submit technical data including the following:
- Technical description and specifications of each generating set, including output curves for base load and stand-by conditions, alternator and engine data, automatic voltage regulator, synchronising and load sharing modules and auxiliaries.
- Net continuous rated output.
- Net short-time rated output.
- Voltage regulation grade.
- Generating set efficiency at 50%, 75% and 100% load.
- Evidence that the engine type has previously passed cold starting tests at the minimum ambient site temperature.

Shop drawings
Submit shop drawings indicating the following:
- Location and size of fuel tanks.
- Physical size of generating set base and clearances for maintenance.
- Location and estimated size of control and distribution boards.
- Maximum mass and overall dimensions of each separable assembly.
- Access clearances for operational maintenance and dismantling.
- Control diagrams.
- Details of foundations and anti-vibration mountings.

2 PRODUCTS

2.1 GENERAL

Multiple generating sets
For multiple generating sets operating in parallel, provide generating sets of the same make and type.

Mounting
Mount the engine and alternator units on a common structural steel frame to support the generating set assembly and the engine local control board.

Coupling
Directly couple the engine and generator shafts with a self-aligning type coupling, capable of transmitting the engine maximum output torque under operating conditions, including starting and overload.

2.2 ALTERNATORS

General
Voltage waveform: Sinusoidal, with total wave form deviation not exceeding 10%.
Excitation: Provide self-regulated brushless type exciters.
Overspeed: Withstand a speed of 1.2 times unit rated speed for both alternator and engine.
Alternator underspeed withstand: Normal operation at net continuous rated output at a speed of 0.95 times unit rated speed, without overheating.
Number of poles: 4.
Enclosure classification: IP21, with screened ventilation openings.

Anti-condensation heaters
Provide at least 2 anti-condensation heaters within the winding enclosure.
Rating: Rate heaters to maintain the windings and insulation at least 6°C above ambient temperature when the alternator is at rest and one heater is in service.
Location: Locate a heater at each end of alternator windings in a position which allows heat transfer to the winding insulation by convection, without exceeding maximum allowable insulation temperature. Do not fix heaters to windings.
Terminations: Connect heaters to separate identified terminals within a separate accessories terminal box which is connected to a permanent supply.
Connection diagram: Provide a connection diagram for the heaters. Locate within the terminal box.

Winding thermistors
Provide thermostors to alternator stator windings.
Thermistor type: Positive temperature coefficient.
Thermistor temperatures:
- Engine shutdown: 160°C.
- Winding temperature high pre-alarm: 140°C.

Terminal boxes
Construction: Provide metal terminal boxes. Size to allow the current transformers, power and control cables and cable lugs to be neatly installed and terminated with necessary clearances between live parts and the box, and without placing undue strain on termination points.
Supply cable terminal box: Provide removable lid and side covers.
Terminals: Provide star connected windings. Bring both ends of each winding out to separate terminals. Establish a neutral terminal.
Sealing: Provide neoprene or bonded cork gaskets between terminal boxes and their frames and covers.
2.3 ENGINES

General
Sizing: When sizing the engine, take into account the nature of connected loads including auxiliaries, harmonics and transient operation.

Bearings: Provide front and rear main bearings, so that crankshaft alignment is not affected by dismantling of the alternator.

Governing
Provide electronic or mechanically controlled governors which enable engines to operate continuously at 1480 r/min from no-load to the maximum rated electrical load connected to the alternator. Provide filters which ensure that harmonics or switching spikes generated by the load do not interfere with the operation of the governor, overspeed or underspeed cut out devices.

2.4 FUEL STORAGE

General
Provide daily fuel tank capacity and bulk storage capacity to the capacities identified in the Fuel Storage Capacity Schedule.

2.5 CONTROLS

General
Provide automatic and manual modes, or manual modes only, depending on generator set capacity to start and shut down generating sets in the selected sequence and, if operating in parallel, share the load in proportion to their rated kW capacities.

Manual sequence control
Provide controls to manually synchronise and shut-down each generating set. Include emergency stop, meters, selector switches, check synchroniser and status indicating lights.

Automatic start control
Provide for the following:
- When a “start” signal is received, generating sets start automatically, come on-line and, when synchronised, connect to the load.
- Connection of alternators for sequential control of load sharing/shedding.
- Shutdown of alternate machines.

Automatic engine shutdown
Provide for generating sets to run to suit the load demand until receipt of the mains “restored” signal is received. At this point the automatic sequenced engine shutdown signal must be activated after an adjustable time delay of 0 – 30 min.

Emergency and fault shutdown
Provide a shutdown control system which disconnects the alternators, and shuts down engines upon the occurrence of fault conditions.

Provide for the following conditions to register as audible and visible alarms and to cause each generating set main circuit breaker to open immediately and each generating set to immediately shutdown:
- Emergency stop push-button: Pressed.
- Generating set: Over voltage.
- Generating set: Over current.
- Engine: Overspeed.
- Engine oil pressure: Low.
- Daily fuel tank: Low.
- Jacket water temperature: High.

Automatic synchronising
Provide synchronising modules which automatically synchronise each incoming alternator supply frequency and phase angle to the live busbars.

Emergency stop push-buttons
Generating sets < 2 m long: Provide one push-button per generating set.
Other generating sets: Provide 2 push-buttons per generating set. Locate one on each side or locate one of the push-buttons in the engine local control board.
Type: 40 mm diameter red, palm operated type mounted in a metal wall box. Wire to disconnect the generator and immediately shut down the engine when the controls are in the automatic or manual mode.

2.6 CONTROL PANELS

General
Provide control panels, switchgear and controlgear assemblies required to enable the safe operation of the generating set and the interconnections with the low voltage supply service.

Engine local control board
For each generating set, provide the following minimum level of information and equipment:
- Key operated local engine start/stop control.
- Controls for auto/off/manual/load test.
- Emergency manual shutdown.
- Speed indicator, kW meter, frequency meter, ammeter, and hours run meter.
- Indicator showing generating set under local control.
- Oil pressure indicator.
- Coolant temperature indicator.
- Automatic voltage regulator consisting of the following:
  - Switch to select manual or automatic voltage control.
  - Solid-state type automatic voltage regulator.
- Under and overvoltage sensing.
- Over and underspeed sensors.

2.7 BATTERIES AND CHARGERS

General
Provide separate batteries and charger systems for the following:
- Engine start.
- Control and alarm functions.

Chargers – control and alarm batteries
Select the charger to suit the batteries supplied.

2.8 STARTING

Electric starting
Provide starter motors, batteries and chargers, and associated control equipment to automatically start each engine.

Wiring: Wire starter motors so that starter motor solenoid contacts are on the active side and field windings are at earth potential when the motor is de-energised. Provide an interlock, connected directly to the engine, to prevent the starter motor operating when the engine is running.

Starting batteries
Locate in proprietary battery holders attached to the generating set, or on purpose-built stands next to the set and constructed of timber or other corrosion resistant material. Isolate batteries from vibration.
Capacity: Sufficient to crank the engine for 3 successive attempted starts, repeated at 5 min intervals.
Isolator: Provide a lockable isolator to prevent accidental starting.

Starting batteries chargers
Mains power: Connect chargers to the mains power to ensure that power is maintained to the charger under all supply conditions.

2.9 ACOUSTIC ENClosures

General
Provide weatherproof acoustic enclosures to surround generating sets, including inlet and outlet sound attenuators.
Sound pressure level limit
85 dB (A) at 12 locations 1 m from the enclosure exterior surface, at 1.5 m above floor level, measured with the generating set operating at constant maximum rated full load output, with doors closed and service penetrations sealed.

Doors
Provide doors of same material as the enclosure. Provide door stays to each door.

Ventilation
Provide ventilation to the enclosure so that:
- With generating sets running at full rated output the enclosure temperature rise does not exceed 10°C.
- Hazardous concentrations of toxic or explosive fumes and gases are prevented.

3 EXECUTION

3.1 GENERAL

Plinths
Provide reinforced concrete plinths for floor mounted equipment, sized to suit equipment footprints.

Resilient mounts
Provide at least 6 resilient mounting blocks between the frame and the plinth.

Drip trays
Provide removable drip trays under those parts of the assembly where fuel or lubricant leakage may occur. Provide overflow outlet pipes taken to a point where a receptacle can be fitted under the pipe outlet.
Capacity: At least 1.5 times the oil capacity of the engine sump.
Material: 1.6 mm galvanized steel with brazed joints and rolled edges.

3.2 ENGINE COOLING

General
Provide a cooling system consisting of radiators, fans and pumps.
Cooling air ductwork: Connect the cooling air outlet to generator room cooling air outlet.

3.3 ENGINE AIR INTAKE

General
Filters: Provide dry type air intake filters of sufficient capacity to permit continuous engine operation for 200 hours before filter servicing becomes necessary.
Fans: Provide a fan selected for the installed system air pressure drop. Include power absorbed by the fan under site operating conditions when calculating generator output.

3.4 EXHAUST SYSTEM

General
Provide exhaust piping from the engine complete with silencers, piping, ductwork, supports and expansion devices.

Weatherproofing
Provide weatherproof flashing, sleeves and acoustic seals where the exhaust system penetrates the roof or external walls.

3.5 FUEL SYSTEM

Stop valves
Provide stop valves on the inlet to, and outlets from, the daily service tank.

3.6 COMPLETION

Completion tests
For each generating set carry out the following:
- Check tightness of connections and securing devices.
- Verify correctness of operation of protection devices and systems including sensor settings. Simulate actual conditions as far as possible, in order to test responses to faults imposed.
- Cold start with the engine having been at rest for the previous 24 hours.
- Continuous operational trial consisting of:
  - 4 hours at 100% rated power.
  - 1 hour at 110% rated power.
  - 30 min at 75% rated power.
  - 30 min at 50% rated power.
- Record fuel consumption for each step of the continuous trial.
- Continuous operational trial: During the trial, measure the following at maximum intervals of 30 minutes:
  - Generator kW and kVAR output.
  - Generator output voltage.
  - Generator output current.
  - Generator output frequency.
  - Oil pressure and water temperature.

Synchronisation and load sharing tests: For generating sets running in parallel perform tests to verify automatic synchronisation and load sharing including the following:
- Sequence start and shutdown of each generating set.
- Parallel operation of generating sets.
- Synchronising of generating sets.
- Operation of controls, switchgear and auxiliaries.

Temporary test loads
Provide test loads including power and control wiring, ancillary equipment and test instruments to achieve the kW, kvar and necessary load steps.
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5.9 Window Coverings

6.0 Finish
6.1 Plastering
6.2 Cementitious Toppings
6.3 Tiling
6.4 Vinyl Finishes
6.5 Carpets
6.6 Painting

7.0 Mechanical Services
7.1 Mechanical Services

8.0 Water Services
8.1 Water Services

9.0 Electrical Services
9.1 Electrical Services
9.2 Generating Sets