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1.1 PRELIMINARIES

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 person 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 Engineer 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 specifically identified in the Contract Documents as client supplied products 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.
1.2 GENERAL REQUIREMENTS

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.
- 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 UNOPS engineer.
- 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.

NOTE: Alternative locally available and used testing methods and regulations may be proposed by the contractor as a part of their bid proposal, but are subject to UNOPS approval and acceptance.

2.2 MATERIALS AND COMPONENTS

All manufactured items must new and be approved by the UNOPS Site Supervisor prior to their purchase and installation.

The material provided by the Contractor will be of a suitable quality for the intended purpose. All materials used will comply with applicable EURO-DIN standards. Where EURO-DIN standards are not applicable, other international standards will apply such as ASME, ASTM, ACI, IEEE, and ASHRAE.

Where a specific product or supplier is identified, the Contractor will interpret the specification to read as stated or of equal quality.
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 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.

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.
2.1 DEMOLITION

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 remains vested with the Employer or Client.
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 prevailing site conditions or as specifically proscribed in the Contract Documents.
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: 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.
2.2 SITE PREPARATION

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 drip line, 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.
2.3 EARTHWORK

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.
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.

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.

All foundations shall be carried to good bearing soil and to the minimum depth below finish grade as indicated on the design drawings. If the requisite bearing is not encountered at the indicated minimum depth, or should over-excavation occur, the following shall be complied with:

a. Minor variations shall be corrected by the use of a lean concrete having an ultimate strength in excess of 70 kg/cm².

b. Major variations shall be referred to UNOPS Engineering for resolution.

Unless otherwise specified on the design drawings or specifications, earth fill beneath foundation shall be Class I structural fill.

The final work of soil excavating and earth filling shall be completed just prior to the placing of the reinforcing steel and concrete. In order to prevent excessive moisture changes in the foundation-supporting soil, the following options are recommended for all spread footing, mat foundation, and mass excavations:

a. Foundations shall be poured within 24 hours of excavation.

b. Water shall be sprayed as required to maintain insitu soil moisture.

c. A 50 mm thick lean concrete slab may be poured as soon as practical after excavation. This slab may also be used to provide a good working surface for construction activities. Lean concrete shall have an ultimate strength in excess of 70 kg/cm².

Prior to pouring the seal slab (or foundation concrete if seal slab is not necessary) the Engineer shall inspect the foundation subgrades material to ensure it is suitable for supporting footings. Should the
material(s) be different than those revealed by the borings, the Engineer shall decide on corrective measures, if necessary, to ensure the satisfactory performance of the foundation soils. The corrective measures may consist of one or more of the following:

- a. Removal of the foundation subgrades material to a certain depth and replacing it with compacted structural fill/lean concrete.
- b. Pumping out ground water from or around the foundation excavation.
- c. Sprinkling of water on dry competent subgrades soils, etc.

**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.

The placement and compaction criteria of fill shall be to the approval of the Engineer.
2.3.1.7 All excess or unsuitable excavated material is to be removed from site and taken away to a locally approved dumping site.

3.9 **COMPACATION 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.
2.4 SERVICE TRENCHING

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.
2.5 LANDSCAPE – WALLS AND FENCES

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so inspection may be made of the following:
- Setting out before commencement of construction.
- Filter fabric and subsurface drainage in place before backfilling.

2 PRODUCTS

2.1 TIMBER

Hardwood
All hardwood in timber fences is to be best quality without any rot, significant knots, twists, or other defects which may affect its strength.
Preservative treatment: Provide only timbers with preservative treatment painted on the timbers surface where the timber is in the ground, or ensure that all timber is highly resistant to rot.

2.2 STEEL

Steel tubes and channels
All steel tubes and channels used for posts, rails, stays are to be painted or galvanised to ensure the maximum lifetime for the item without significant maintenance. Refer to Finishes Schedule.

Wire
Chainwire, cable wire, tie wire and barbed wire are to be galvanised or other suitable metallic finish for maximum lifetime.

2.3 CONCRETE WALLS

General
Concrete walls and concrete foundations are to be constructed as shown on the drawings.

2.4 STONE WALLS

Walling stone
Natural stone: Stone of uniform quality, sound and free from defects liable to affect its strength, appearance or durability.
Field stone: Local weathered uncut random sized natural stones.
Quarried stone: Cut or uncut random or regular size stone.

2.5 CRIB WALLS

General
Type: Proprietary system of interlocking precast concrete units with selected backfill placed and compacted progressively to form a retaining wall.

2.6 GABION WALLS

General
Type: Proprietary system of rock filled wire baskets.

2.7 BRICK WALLS

General
Brick walls on stone or concrete foundations are to be constructed as shown on the drawings.
2.8 EARTH BLOCK WALLS
General
Earth block walls on stone or concrete foundations are to be constructed as shown on the drawings.

2.9 FILTER FABRIC
General
Type: Polymeric fabric formed from a plastic yarn composed of at least 85% by weight of propylene, ethylene, amide or vinyledenechloride and containing stabilisers or inhibitors to make the filaments resistant to deterioration due to ultraviolet light.
Protection
Provide heavy duty protective covering. Store clear of the ground and out of direct sunlight. During installation do not expose the filter fabric to sunlight for more than 14 days.

3 EXECUTION

3.1 GENERAL
Set out
General: Set out the wall and fence lines and mark the positions of posts, gates and bracing panels.
Clearing
Extent: Except trees or shrubs to be retained, clear vegetation within 1 m of the landscape walls. Grub out stumps and roots of removed trees or shrubs and trim the grass to ground level, but do not remove the topsoil.
Excavation
Excavate for foundations and footings.
Earth footings
Backfill with earth around posts, compacting firmly by hand or machine in 150 mm deep layers.
Concrete footings
In ground: Place mass concrete around posts and finish with a weathered top falling 25 mm from the post to ground level.
On slabs: Provide welded and drilled post flanges and fix with 3 masonry anchors per post.
Strip footings: Place mass concrete or reinforced concrete footings for walls. Refer to drawings for details.

3.2 GATES
Types
Gates are to be constructed with minimum 30 x 30mm steel tube frames for rigidity. Infill panels can be steel sheet, steel mesh, timber boards or other material as identified on the drawings.
Hardware
Provide the following:
- Drop bolt and ferrule to each leaf of double gates.
- Latch to one leaf of double gates.
- Provision for locking by padlock.
- Holding lugs for security bars to inside face of double gates with vehicle access.
- Minimum of 2 hinges for gates 1.2m high. 3 hinges for gates 1.2 to 2.1m high. 4 hinges for gates greater than 2.1m high.
Hand access
General: Where required, provide hand holes to give access from outside to reach locking provision.

3.3 TIMBER FENCING
Timber picket fence
Height (mm): As shown on drawings
Maximum post spacing: 2400 mm.

Member sizes (dressed):
- Posts: 90 x 90 mm.
- Rails: 70 x 40 mm.
- Pickets: 70 x 19 mm.

Picket spacing: 125 mm maximum.

Footing type: Earth.

Footing size: 200 mm diameter x 600 mm depth.

**Installation**

General: Mortice posts, taper splice rails and nail twice in mortices. Set pickets and palings clear of the ground.

Picket fence: Nail twice to each rail.

### 3.4 CHAINWIRE BARRIERS

**Fence dimensions**

Maximum post spacing: 3000 mm.

**Component sizes**

Intermediate posts: 42.4 mm diameter, 2.6 mm wall thickness.

End, corner and gate posts: 60.3 mm diameter, 2.9 mm wall thickness.

Chainwire: 3.15 mm diameter wire woven to form uniform mesh.

- Mesh generally: 50 mm.

Tie wire: 2 mm diameter.

Post and rail barriers:
- Rails and gooseneck stay: 33.7 mm diameter, 2.6 mm wall thickness.

Railless barriers:
- Struts: 42.4 mm diameter, 2.6 mm wall thickness.
- Cable wires:
  - Two strands: 3.15 mm diameter wire.
  - One strand: 4 mm helicoil wire.

Security barriers:
- Chainwire selvedges: Twisted and barbed.
- Barbed wire to security fencing post extensions: Barbs at 95 mm maximum centres.

**Installation**

Posts: Do not splice members except in posts when splice is embedded at least 150 mm into concrete. Fit tightly fitting steel caps to posts, except where fixed to overhead structure.

Chainwire: Lace chainwire to end and gate posts. Tie chainwire twice around members at 250 mm maximum intervals. Twist ends twice and cut off neatly.

Cable wire: Tension cable wire(s) to support chainwire after at least 24 hour curing of concrete footings.

Footing type: Concrete.

- Footing size:
  - Intermediate and end posts: 225 mm diameter x 600 mm depth.
  - Corner posts and gate: 225 mm diameter x 900 mm depth.

Post and rail barriers:
- Rails: Connect rail(s) to posts using bolted split pipe fittings and purpose-made caps and brackets with rail apertures.
- Continuous rail type fences: Join the rails together in long lengths using purpose-made sleeves or socketed connections, and pass them through the apertures of caps and brackets on intermediate posts.
Railless barriers:
- Struts: Provide struts at ends, corners and gates.
Security barriers:
- Security fencing: Strain barbed wire between post extensions.

**Gates**

Frame tubes: 33.7 mm diameter, 2 mm wall thickness.
Chainwire: Match fence.
Maximum width: 3600 mm.

Security barriers:
- Barbed wire security gate extension supports: 26.9 mm diameter, 2 mm wall thickness.
- Barbed wire: Match fence.

### 3.5 STONE WALLS

**Construction**

Select the stones for their locations and lay them in the wall with the minimum of stonecutting.

Footings: Select the largest, flattest and most regular stones for footings, and set them in concrete blinding in accordance with drawings.

Copings: Select stones of reasonably uniform size and finish the top of the wall to a level line or cap with precast concrete sections.

**Retaining walls**

Construction: Where dry stone walls act as retaining walls, construct the stonework to be free draining through the wall. Batter back the wall face 50 – 70 mm for every 300 mm in height. Cap the top of the wall. Backfill progressively, with a layer at least 300 mm thick of porous material, such as coarse aggregate or crushed rock in the size range 20 – 40 mm. Install filter fabric to stop movement of silt into porous material.

Minimum thickness: 450 mm.

Where stone walls are mortared, batter back the wall face 50 – 70 mm for every 300 mm in height. Cap the top of the wall. Backfill progressively, with a layer at least 300 mm thick of porous material, such as coarse aggregate or crushed rock in the size range 20 – 40 mm. Install filter fabric to stop movement of silt into porous material. Install a slotted pipe drain at the bottom of the wall backfill to ensure all water is drained away from the wall face.

Minimum thickness: 450 mm.

### 3.6 CRIB WALLS

**Construction**

Construct walls in conformance with the manufacturer’s written requirements or specific design included in the drawings.

### 3.7 GABION WALLS

**Assembly**

Construction: Assemble the baskets and join them together by wiring along edges both horizontally and vertically before placing the rock fill. Fix the top of the basket by wiring to both the sides and the diaphragms.

### 3.8 BRICK, EARTH BLOCK WALLS

**Construction**

Construct walls in conformance with the specific design included in the drawings. Construction of brickwork and earth blockwork to be in accordance with the relevant specification sections.
2.6 LANDSCAPE – SOILS AND PLANTING

1 GENERAL

1.1 SUBMISSIONS

Suppliers
Obtain statements from suppliers of plant materials, giving the following:
- Particulars of the supplier’s experience in the required type of work.
- Lead times for delivery of the material to the site.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- lawns prepared before seeding
- plant holes excavated and prepared for planting
- setout of gravel paths prepared for filling

2 PRODUCTS

2.1 TOPSOIL

Source
Import topsoil unless the topsoil type can be provided from material recovered from the site.

Additives
Use additives to raise topsoil to the required standard approved by the Engineer.

2.2 COMPOST AND FERTILISER

Compost
Provide well rotted vegetative material or animal manure, free from harmful chemicals, grass and weed growth.

Fertiliser
Provide proprietary fertilisers, delivered to the site in sealed bags marked to show manufacturer or vendor, weight, fertiliser type, recommended uses and application rates.

2.3 GRAVEL PATHS

Provide paths constructed with consolidated small gravel chippings and concrete edging pavers where shown on plans.

3 EXECUTION

3.1 PREPARATION

Vegetative spoil
Remove vegetative spoil from site. Do not burn without the specific approval of the Engineer.

3.2 ROCKWORK

Rock work
General: Place rocks while ground formation work is being carried out. Provide site rock, otherwise provide imported rock. Bury rock two-thirds by volume, with weathered faces exposed. Protect the weathered faces from damage.
Site rock: Stockpile for future placement and accessibility for lifting. Dispose of other rock off site.
Imported rock: Provide rock which has been selected before delivery.

3.3 SUBSOIL

Ripping
Rip parallel to the final contours wherever possible. Do not rip when the subsoil is wet or plastic. Do not rip within the dripline of trees and shrubs to be retained.
Ripping depths: Rip the subsoil to the following typical depths:
- Compacted subsoil: 300 mm.
- Heavily compacted clay subsoil: 450 mm.

Planting beds
Excavated: Excavate to bring the subsoil to at least 300 mm below finished design levels. Shape the subsoil to fall to subsoil drains where applicable. Break up the subsoil to a further depth of 100 mm.
Unexcavated: Remove weeds, roots, builder’s rubbish and other debris. Bring the planting bed to 75 mm below finished design levels.

Cultivation
Minimum depth: 100 mm.
Services and roots: Do not disturb services or tree roots; if necessary cultivate these areas by hand.
Cultivation: Thoroughly mix in materials required to be incorporated into the subsoil. Cultivate manually within 300 mm of paths or structures. Remove stones exceeding 50 mm, and weeds, rubbish or other deleterious material brought to the surface during cultivation. Trim the surface to design levels after cultivation.

Additives
Apply additives after ripping or cultivation and incorporate into the upper 100 mm layer of the subsoil. Refer to the Soil additives schedule.

3.4 TOPSOIL

Placing topsoil
Spread the topsoil on the prepared subsoil and grade evenly. Ensure that grassed areas may be finished flush with adjacent hard surfaces such as kerbs, paths and mowing strips.
Contamination: Where diesel oil, cement or other toxic material has been spilt on the subsoil or topsoil, excavate the contaminated soil, dispose of it off the site, and replace it with site soil or imported topsoil.
Finishing: Feather edges into adjoining undisturbed ground.

Consolidation
Compact lightly and uniformly in 150 mm layers. Produce a finished topsoil surface which has the following characteristics:
- Smooth and free from stones or lumps of soil.
- Graded evenly into adjoining ground surfaces.
- Ready for planting.
Refer to the Soil additives schedule.

Topsoil depths
Spread topsoil to the following typical depths:
- Excavated planting areas: If using organic mulch, 200 mm.
- Irrigated grassed areas generally: 150 mm.
- Non-irrigated grass areas: 100 mm.

Surplus topsoil
Spread surplus topsoil on designated areas on site, if any; otherwise, dispose off site.
Designated areas to be determined by the Engineer.
3.5 GRASS SEEDING

Preparation
Prepare the areas to be sown. Spread the fertiliser evenly over the cultivated bed within 48 hours before sowing, and rake lightly into the surface. If a prepared area becomes compacted from any cause before sowing can begin, rework the ground surface before sowing.

Sowing
Do not sow if frost is likely before the plant has reached an established state, or in periods of extreme heat, cold or wet, or when wind velocities exceed 8 km/h. Provide even distribution. Lightly rake the surface to cover the seed.

Rolling
Roll the seed bed immediately after sowing.
Roller weight (maximum):
- Clay and packing (heavy) soils: 90 kg/m width.
- Sandy and light soils: 300 kg/m width.

Watering
Before germination: Water the seeded area with a fine spray until the topsoil is moistened to its full depth. Continue watering until germination to keep the surface damp and the topsoil moist but not waterlogged.

After germination: Water to maintain a healthy condition, progressively hardened off to the natural climatic conditions.

Germination
Maintain sown areas until healthy grass covers the whole of the seeded area.
Reseeding: If germination has not been attained within one month, reseed the sown areas.

Weeding
Remove weeds that occur in sown areas. Where necessary spray with a selective weedkiller for broad leafed weeds. Do not spray grass seeded areas within 3 months of germination.

Protection
Protect the newly sown areas against traffic until well established. Protection method to be approved by the Engineer.

Mowing
Mow to maintain the grass height within the required range. Do not remove more than one third of the grass height at any one time. Carry out the last mowing within 7 days before the end of the planting establishment period. Remove grass clippings from the site after each mowing.

3.6 PLANTS

Plants
Characteristics: Provide plants with the following characteristics:
- Large healthy root systems.
- Vigorous, well established, free from disease and pests.
- Suitable for planting in the natural climatic conditions prevailing at the site.

Replacement: Replace damaged or failed plants with plants of the same type and size.

Plant containers
Supply plants in weed-free containers of the required size.

Open rooted stock: If trees are to be supplied as open rooted stock, ensure this is appropriate to the species, variety, size, and time of year for planting.

Refer to the Plant Schedule.

Labelling
Label at least one plant of each species or variety in a batch with a durable, readable tag.

Storage
Deliver plant material to the site on a day to day basis, and plant immediately after delivery.
### 3.7 PLANTING

**Individual plantings in grassed areas**
Excavate a hole to twice the diameter of the root ball and at least 100 mm deeper than the root ball. Break up the base of the hole to a further depth of 100 mm, and loosen compacted sides of the hole to prevent confinement of root growth.

**Locations**
If it appears necessary to vary plant locations and spacings to avoid service lines, or to cover the area uniformly, or for other reasons, obtain directions from the Engineer.

**Planting conditions**
Do not plant in unsuitable weather conditions such as extreme heat, cold, wind or rain. In other than sandy soils, suspend excavation when the soil is wet, or during frost periods.

**Watering**
Thoroughly water the plants before planting, immediately after planting, and as required to maintain growth rates free of stress.

**Placing**
Remove the plant from the container with minimum disturbance to the root ball, ensure that the root ball is moist and place it in its final position, in the centre of the hole.

**Fertilising**
In planting beds and individual plantings, place fertiliser pellets around the plants at the time of planting.

**Watering basins for plants in grass**
Except in irrigated grassed areas and normally moist areas, construct a watering basin around the base of each individual plant, consisting of a raised ring of soil capable of holding at least 10 L.

### 3.8 STAKES AND TIES

**Stakes**
Use Hardwood stakes, straight, free from knots or twists, pointed at one end.

Drive stakes into the ground at least one third of their length, avoiding damage to the root system.

**Stake sizes:**
- For plants ≥ 2.5 m high: Three 50 x 50 x 2400 mm stakes per plant.
- For plants 1 – 2.5 m high: Two 50 x 50 x 1800 mm stakes per plant.

**Ties**
Provide ties fixed securely to the stakes, one tie at half the height of the main stem, others as necessary to stabilise the plant.

**Tie types for plants < 2.5 m high:** 50 mm sack webbing stapled to the stake.

### 3.9 GRAVEL PATHS

**Pavement**
Use small size gravel in layers not exceeding 150mm thick to form paths where shown on drawings. Colour and type of gravel to approval of Engineer. Retain sides of path with either:
- Precast decorative concrete paving edge strips, colour to approval of Engineer.
- Concrete kerbs

### 3.10 PLANTING ESTABLISHMENT

**Period**
The planting establishment period commences at the date of practical completion and finishes at the date of final certificate.

**Existing planting and grass**
Where existing grass or planting is within the landscape contract area, maintain it as for the corresponding classifications of new grass or planting.
**Recurrent works**
Throughout the planting establishment period, carry out maintenance work including, watering, mowing, weeding, rubbish removal, reseeding, staking and tying, replanting, cultivating, and keeping the site neat and tidy.
1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Base or sub-grade 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.

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 drawings and specifications.
- 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

<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 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.

### TABLE I - **MINIMUM COLD WEATHER TEMPERATURE**

<table>
<thead>
<tr>
<th>AIR TEMPERATURE °C</th>
<th>MINIMUM CONCRETE TEMPERATURE °C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For Sections With Smallest Dimension Less Than 300 mm</td>
</tr>
<tr>
<td>-1 to 4</td>
<td>16</td>
</tr>
<tr>
<td>-18 to -1</td>
<td>18</td>
</tr>
<tr>
<td>Below -18</td>
<td>21</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 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

<p>| Concrete temperature at time of discharge (°C) | Maximum elapsed time (hours) |</p>
<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.

**Finishing, Curing, Form Removal and Patching**

Finishing - Unless otherwise required on the design drawings or specifications for the project, concrete surfaces shall be finished as follows:

**Pavement and Walks**

a. Top surfaces shall be brought to proper level with a screed.

b. After the water sheen has disappeared, the surface shall be floated with wood or metal floats or with a finishing machine using float blades.

c. Before the concrete has thoroughly hardened, the surface shall be roughly scored using a steel wire or stiff coarse fibre broom. The depth of scoring shall not exceed 3 mm.

d. Control joints may be formed by saw cut or cast-in-place plastic strips. Joints to be sawed shall be done as soon as the concrete surface is firm enough not to be torn or damaged by the blade.

**Building Floor and Roof Slabs**

a. Screed and float as specified in Paragraph 4.4.8.1.1 for pavements and walks.

b. All roof slabs and floor slabs receiving a tile-floor or other type of finish shall be steel trowel finished.

c. Other building floors shall be given a wood float finish.

**Equipment Foundations, Building Foundations, Trenches, Pits, Boxes, and Sumps**

a. Screed and float as specified in Paragraph 4.8.1.1 for pavements and walks.

b. A wood float finish shall be provided. Surfaces to receive grout or concrete shall be roughened.

c. No finish is required for surfaces exposed to forms other than patching of surface defects.

**Curing**

Curing to maintain a satisfactory moisture content and concrete temperature shall be performed using the applicable methods and procedures recommended in ACI 305R, ACI 306R, and ACI 308.

Curing by any of the methods specified shall continue for a minimum of 7 days for concrete at a temperature of 50°F (10°C) or more. When high early strength concrete is used, the curing period may be reduced to a minimum of 3 days.

During the curing period, the concrete shall be protected from damage by construction equipment, materials, rain, running water, heavy shock, and vibration.
In cold weather, when the mean daily temperature is less than 4°C, the concrete shall be maintained between 10°C and 21°C for the required curing period. Necessary arrangements shall be made in advance for heating, covering, insulating, or enclosing the concrete work to maintain the required temperature and moisture conditions. When heaters using combustible fuels are used in an enclosure, the heaters shall be vented to the outside of the enclosure.

In hot weather, necessary arrangements shall be made in advance for protective measures needed to prevent rapid drying of the concrete. These protective measures shall be started as quickly as finishing and hardening will allow.

Form Removal

The age after which forms may be removed from the concrete is given in Table IV. The values given in Table IV shall be considered as a minimum.

The actual time of removal shall be determined by inspection and good judgement.
Prior to or after removal of forms, curing protection shall continue, for the period of time shown in Table IV or for the period of time specified in Paragraph 2.3.5.2.2, whichever is greater.

**TABLE IV - MINIMUM AGE FOR SAFE REMOVAL OF FORMS – DAYS**

<table>
<thead>
<tr>
<th>CONSTRUCTION</th>
<th>PROBABLE MEAN OUTSIDE TEMPERATURE AFTER PERIOD OF PROTECTION</th>
<th>CONCRETE TEMPERATURE DURING PROTECTION</th>
<th>TYPE OF CEMENT (ASTM C150)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>10°C</td>
<td>21°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>III</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>III</td>
</tr>
<tr>
<td>Plinths, Walls, Columns and Other Vertical or Near Vertical Sections</td>
<td>Above 10°C</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>0°C to -4°C</td>
<td>11*</td>
<td>6*</td>
</tr>
<tr>
<td></td>
<td>-4°C to -9°C</td>
<td>21*</td>
<td>6*</td>
</tr>
<tr>
<td></td>
<td>Below -9°C</td>
<td>29*</td>
<td>26*</td>
</tr>
<tr>
<td>Formed Grade Beams, Elevated Slabs and Beams, Spans 3m or less</td>
<td>Above 10°C</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0°C to -4°C</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>-4°C to -9°C</td>
<td>21</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Below -9°C</td>
<td>29</td>
<td>25</td>
</tr>
<tr>
<td>Spans Larger than 3m</td>
<td>Above 0°C</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Below 0°C</td>
<td>28</td>
<td>28</td>
</tr>
</tbody>
</table>

NOTE: * Forms may be removed at two days for concrete using Type I cement or at one day for concrete using Type III cement. However, curing protection must be continued for the period shown for the expected exposure condition.

The concrete structure shall be evaluated for the effect of any superimposed loadings applied before the concrete attains its compressive design strength.

Patching
Immediately after form removal all exposed concrete surfaces shall be inspected for defects. Fins, honeycomb, and other defects shall be repaired before the concrete is dry. Defective areas such as honeycomb shall be cut back to sound material before repair.

The patching material shall match the color of the original concrete as closely as possible. One-third of the gray cement may be replaced with white Portland cement to help in getting a color match.

**Backfill**

Unless otherwise specified on the design drawings or specifications, backfill around foundations shall be Class II structural fill.

**Formwork**

Formwork shall be designed, erected, supported, braced, and maintained so that it will sustain all vertical and lateral loads until such loads can be supported by the concrete structure itself.

Forms shall conform to the shape and dimensions of the members shown on the design drawings.

Forms and their supports shall be designed so as not to damage previously placed concrete.

Forms shall be true, rigidly constructed, and sufficiently tight to prevent leakage of cement paste.

All forms for exposed work shall be free of defects likely to cause imperfections on the surface of the concrete.

Forms shall be suitable for the work to be performed and may be of dressed lumber, plywood, metal, or other suitable materials.

Chamfer strips are required for all exposed corners.

Form material which is to be reused shall have damaged parts repaired and the concrete side thoroughly cleaned before reusing.

Temporary openings shall be provided at the base of column and wall forms to facilitate cleaning and inspection.

Adjustable type shoring can be used for supporting roof forms or elevated floors.

Tolerances for forms shall be as follows:

Variations from plumb in columns, piers and walls is 6 mm in 3 m, but not to exceed 25 mm total.

Variation from level in slab and beam soffits (horizontal undersides) 6 mm in 3 m but not more than 18 mm unless otherwise noted on the design drawings. Where necessary to maintain this tolerance, the formwork shall be cambered to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads.
Form ties shall be standard shop ties or screw ties. The holes left by the removal of the tie ends shall be patched with mortar.

The form release agent shall be applied before any bar supports and reinforcing steel is placed. Excess form release agent shall not be allowed to stand in puddles in the form or come in contact with concrete against which fresh concrete will be placed.

Forms shall be constructed to facilitate their removal without damage to the concrete. Forms shall be preferably removed in the following order (1) columns, (2) sides of beams and girders, (3) bottom of slabs, beams, and girders.

**Reinforcement and Anchor Bolts**

**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 by the UNOPS Site Supervisor.

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 Engineering. Welded splices shall not be used.

Welded wire fabric used in structural concrete shall have lapped splices such that the overlap between the outermost cross-wires of each fabric sheet is not less than the spacing of the cross-wires plus 50 mm. Fabric shall be supported, in the same manner as reinforcing bars, to place the fabric in its proper location within the concrete member.

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.

In lieu of adequate support of the welded wire fabric, the fabric shall be lifted during placing of concrete to ensure proper positioning in the concrete.

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.

Unless otherwise specified on the design drawings, the minimum concrete cover over reinforcement shall be as given in Table V (see next page).

**TABLE V – MINIMUM CONCRETE COVER**
<table>
<thead>
<tr>
<th>REINFORCEMENT LOCATION</th>
<th>MINIMUM THICKNESS OF CONCRETE COVERING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cast against and permanently exposed to earth</td>
<td>75 mm</td>
</tr>
<tr>
<td>Exposed to earth or weather</td>
<td>50 mm</td>
</tr>
<tr>
<td>#19 through #57 bars</td>
<td>50 mm</td>
</tr>
<tr>
<td>#16 bars and smaller</td>
<td>37 mm</td>
</tr>
<tr>
<td>Not exposed to weather or in contact with the ground slabs, walls, joist:</td>
<td></td>
</tr>
<tr>
<td>#57 bars</td>
<td>37 mm</td>
</tr>
<tr>
<td>#36 bars and smaller</td>
<td>18 mm</td>
</tr>
<tr>
<td>Beams, girders, columns</td>
<td>37 mm</td>
</tr>
<tr>
<td>Principal reinforcement, ties, stirrups or spirals</td>
<td></td>
</tr>
</tbody>
</table>

**Anchor Bolts**

Anchor bolts shall be placed as shown on the design drawings and to the following tolerances:

a. Bolt projections: plus 6 mm, minus 0 mm  
b. Bolt location-without sleeves: ±3 mm  
c. Bolt location-with sleeves: ±5 mm

Bolt sleeves with open tops shall be packed to keep concrete out of the sleeve during the pour.

Sleeves shall ultimately be grouted in accordance with C23-1CS.

**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.
3.2 CONCRETE- FINISHES

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.

<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.

3.3 FORMED SURFACES

General
Provide formed concrete finishes in conformance with the drawings.
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.
Floated finishes:
- Sand floated finish: Remove the forms while the concrete is green. Wet the surface and rub using a wood float. Rub fine sand into the surface until a uniform colour and texture are produced.
- Grout floated finish: Remove the forms while the concrete is green. Dampen the surface and spread 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.
3.4 EARTH BLOCK WALLING

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Forms for blocks prior to casting blocks.
- Completed blocks prior to use.
- Damp-proof courses, in position.
- Built-in items, in position.

1.2 TESTS

Unit sampling
Rate: For each test, sample units at the rate of 1 per 500, randomly selected.

Unit tests
Dry density: Field or laboratory test for block in the range of 1200 – 2000 kg/m$^3$.
Absorption:
- Application: Stabilised units for maximum absorption of 2.5% by weight.
- Sample size: 100 mm cube, cut from a sample unit.
Dimensional accuracy:
- Confirm size of block is within an acceptable range of variance not greater than 10mm per 300mm length of block.
Robustness: Unit must remain intact, but corner chipping is permitted, consistent with the unit remaining suitable for wall construction.
Defects:
- Breakages (maximum): 50 x 50 x 50 mm broken off per unit.
- Cracks (maximum): 75 mm long, 3 mm wide, 5 mm deep.

1.3 SAMPLES

General
Colour and texture: Supply sample units indicating the range of likely variation. Label, and store on site under cover when accepted.
- Number: 4.
- Size: Full size.
Facework: Provide a sample panel.
- Size (minimum): 900 mm long x 600 mm high.
- Location to be determined on site.

1.4 TOLERANCES

Tolerances
Conform to the Tolerances table.

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria: Permitted deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal position of any earth wall element specified or shown in plan at its base or at each storey level</td>
<td>45 mm</td>
</tr>
<tr>
<td>Property</td>
<td>Tolerance criteria: Permitted deviation (mm)</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Deviation with a storey from a vertical line through the base of the member</td>
<td>35 mm per 3 m of height</td>
</tr>
<tr>
<td>Deviation from vertical in total height of building (from base)</td>
<td>40 mm</td>
</tr>
<tr>
<td>Relative displacement between loadbearing walls in adjacent storeys intended to be in vertical alignment</td>
<td>40 mm</td>
</tr>
<tr>
<td>Deviation (bow) from line in plan in any length up to 10 m</td>
<td>Single curvature: 45 mm</td>
</tr>
<tr>
<td>Deviation from design wall thickness</td>
<td>-20 mm, + 40 mm</td>
</tr>
</tbody>
</table>

2 PRODUCTS

2.1 MATERIALS

Soil particle sizes
Sand: 0.06 – 2.0 mm.
Coarse aggregate: 2.0 – 25 mm.

Soil particle size distribution
Organic content: < 2%.
Clay and silt content: 10 – 30%.
Sand and coarse aggregate content: 30 – 80%.

Water
Clean, fresh, free from impurities.

Crack-control agent
Straw:
- Length: 40 – 60 mm.
- Ratio: 5 kg to 30 kg of straw/m³ of soil.

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

Mortar
Earthen mortar: Same mix as for the units, but with added sand, and no straw or particles over 6 mm.
Thoroughly soak and mix to prevent clay-balling.
Water repellent additive may be added to improve water resistance. Provide a submission to the Engineer for approval.

2.2 COMPONENTS

Damp-proof courses
Material: Embossed Polythene sheeting. Install sheeting at base of all walls to stop moisture rising up wall structures.

Masonry units
Formed size (h x w x l): 100 x 250 x 350 mm unless approved otherwise by the Engineer.

Nailing blocks
Solid timber, or hollow timber box filled with earthen mortar. Timber unseasoned or thoroughly pre-wetted.
Steel components, including reinforcement
All steel components to be galvanised for maximum durability after incorporation into the structure.

Window and Door lintels
Lintels: Use steel, concrete or timber lintels in accordance with the manufacturers’ technical literature or conform to the Steel angle and T-lintels table.

<table>
<thead>
<tr>
<th>Steel angle and T-lintels table</th>
<th>Maximum span (mm)</th>
<th>Wall height above ≤ 600 mm</th>
<th>Wall height above &gt; 600 mm, ≤ 1800 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Angle lintel size</td>
<td>T-Lintel dimensions: H x W x T (mm)</td>
<td>Bearing min. (mm)</td>
</tr>
<tr>
<td>1000</td>
<td>Two 75 x 50 x 5 Unequal angles</td>
<td>81 x 150 x 6</td>
<td>100</td>
</tr>
<tr>
<td>2000</td>
<td>Two 100 x 75 x 6 Unequal angles</td>
<td>136 x 150 x 6</td>
<td>150</td>
</tr>
<tr>
<td>2400</td>
<td>Two 125 x 75 x 8 Unequal angles</td>
<td>156 x 150 x 6</td>
<td>150</td>
</tr>
<tr>
<td>2800</td>
<td>Two 150 x 90 x 8 Unequal angles</td>
<td>158 x 150 x 8</td>
<td>200</td>
</tr>
<tr>
<td>3000</td>
<td>Two 150 x 90 x 10 Unequal angles</td>
<td>160 x 150 x 10</td>
<td>200</td>
</tr>
</tbody>
</table>

Timber lintels
Size: Width of the wall and in conformance with the Timber lintels height table.
Grade: Best quality of imported Russian timber or suitable approved local timber.
Bearing: 300 mm (minimum).

<table>
<thead>
<tr>
<th>Timber lintels height table</th>
<th>Maximum span (mm)</th>
<th>Lintel height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1200</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>1800</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>2400</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>3000</td>
<td>250</td>
</tr>
</tbody>
</table>

Timber fixing plates
Size: 200 x 50 mm (minimum).

Holding-down bolts
Type: 10 mm diameter threaded rod.
Termination: Horizontal 5 x 100 x 200 mm steel plate, weld-fixed, or with nuts.
Depth of embedment:
- Length (minimum): 450 mm.

3 EXECUTION

3.1 FABRICATION

Mixing
General: Moisten soil to liquid limit. Leave pit-mixed mud wet overnight.
Stabilising: Add cement at 2.5 – 15% by mass.
Crack control: Add straw at 5 – 30 kg/m³.

Hot weather: If placement of walling is to proceed when surrounding outdoor shade temperature exceeds 32ºC, submit proposal.

**Forming**
Press mix into forms on a bed of sand on the ground or on concrete. Lift forms vertically and wash. Do not move units until cured.

**Curing**
General: Sun-dry the units for more than 7 days in situ (under shelter in hot, dry weather) after forming. Then tip the units on one side and sun-dry in situ for another 7 days.

Cement stabilised: Cover blocks with plastic sheet for at least 24 hours after casting.

**Storage**
Stack cured units close to point of use on boards off the ground. Stack on edge, 2 – 3 rows high. Orient stacks for equal exposure to sun and wind on both faces. Protect the tops of stacks against the weather.

### 3.2 LAYING UNITS

**General**
Drying: Do not lay units until they are dry and at least 28 days after forming.

Unstabilised units: Sprinkle with water before laying. Relay disturbed units in fresh mortar.

Temperature: Do not lay when ambient temperature is or is expected to be < 5ºC within 48 hours of placement. Do not lay on frozen materials.

Daily progress: Establish leads at corners. Step back incomplete walls, do not tooth. Cover incomplete work at the top. Lay a maximum of 500 – 700 mm height per day.

Voids at dissimilar materials: Fill with earthen mortar.

Protection: Protect tops of walls from rain until the roof is in place.

**Joints**
Bedding: Full flush type, with no open head joints.

Bond: Running bond. Overlap units 100 mm.

Type: Flush, 13 – 19 mm thick. Tool concave at exposed surfaces. Remove excess mortar.

Control joints:
- Spacing as identified on drawings.

**Protection**
Unstabilised units: Do not locate unstabilised units within 100 mm of adjacent floor levels, within 225 mm of adjacent ground levels, within 100 mm of the top of unenclosed walls and parapets, around roof drains, and in other areas where there is risk of moisture.

### 3.3 DAMP-PROOF COURSES

**Location**
At the base of the earth walls above footings or slab (plinth).

**Walls on slabs**
Finish flush with outer face of slab and inner face of wall. Upturn on inside behind skirting and downturn at outer face of slab, at least 25 mm.

**Installation**
General: Lay in long lengths, in a single width. Lay full width at angles and intersections and lap at least 150 mm at joints. Step as necessary.

### 3.4 FIXINGS AND EMBEDDED ITEMS

**Nailing blocks and nailers**
Installation: Build-in as the work progresses. Use nailing blocks to fix all window frames, door frames and other wall mounted fixtures.

Partitions: Nail timber framed partitions to nailing blocks.
3.5 REINFORCEMENT

Installation
Do not cut, weld or grind on site. Build-in as work progresses. Lap 450 mm at splices. Fold and bend at corners so that the longitudinal wires are continuous. Stop 200 mm short of control joints. Place in centre of the width of the wall, and in the bedding joint.
Cover (minimum):
- 75 mm for exposed surfaces.
- 25 mm for protected surfaces.
Vertical intervals (maximum): 500 mm, for full height of the wall.

3.6 STEEL LINTELS

Installation
Do not cut, weld or grind on site. Build-in as work progresses. Keep lintels 10 mm clear of heads and frames. Install T-lintels with horizontal component at the bottom, centred in the width of the wall.
Propping: Temporarily prop lintels during construction and until the wall reaches its required strength.

3.7 TIMBER LINTELS

Installation
Build-in as work progresses. Keep lintels 10 mm clear of heads and frames.

3.8 PIPES AND CONDUITS

Installation
Installation: Lay conduits and water pipes in mortar joints as far as possible. Otherwise lay in chases.
Cover (minimum): 100 mm, if built-in.
Chases: Maximum depth 50 mm. Run vertically, not horizontally. Do not chase in exposed facework. Thicken the walls for larger piping.

3.9 BOND BEAMS

Positions
Provide a continuous bond beam to bearing walls, at framed floor and at roof bearing levels. Build-in as work progresses. Anchor the floor and roof structures to the bond beams. Bond beams may be concrete, timber or steel beams as identified on the drawings.
Position: Centre on the wall.
Bedding: Mortar levelling course.

3.10 HOLDING-DOWN BOLTS

General
Cover (minimum): 75 mm. Location: Refer to drawings for locations, length of holding down bolts.

Installation
Set in perpends and units split lengthwise, in alternating courses. Do not locate within 150 mm of end of wall. Locate in the centre of wall.

3.11 FINISHES

Appearance
Marks and stains: Remove at completion.
Efflorescence: Remove before sealing or rendering.

Mud render
General: Render the exteriors of walls made of unstabilised units.
Preparation: Brush the substrate, score and moisten.
Mix: 3:1 clay:clean sand, with straw reinforcing, and enough water to make a paste.
Render: Two coats, each 5 – 7 mm thick.
Finish: Polish the coating using sheepskin or small rounded stones.
3.12 TEMPORARY WORK

Facework sample panel
If not incorporated, demolish panel.

Refer to the, BOQ and drawings for details of locations and built in components.
3.5 BRICKWORK

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Set out of brickwork to lintels, arches and other architectural features.
- Damp-proof courses, in position.
- Lintels, in position.

2 PRODUCTS

2.1 MATERIALS

Bricks
Bricks shall be made from good brick earth free from saline deposits, and shall be sand molded. They shall be thoroughly burnt by coal without being vitrified, of uniform and good color, shall be regular and uniform in size, shape and texture with sharp square edges and parallel faces. They must emit a clear metallic ringing sound when struck one against another. They shall be free from flaws, cracks, chips, stones, and nodules of lime or canker. A Brick shall not absorb more than 1/6th of its weight of water after being soaked for one hour.

General
The Engineer prior to use in the Works shall approve the use of bricks. Bricks not meeting the above requirements shall not be used in brickwork. Bricks should have the following dimensions after burning: 250mm x 120mm x 70mm. The unit weight of First and Second Class Bricks shall not be less than 1100 kg/m³. Brickwork shall only commence when the Engineer has approved the bricks. The Contractor may then only change the source of supply of bricks after samples from the new supplier have similarly been

Only well burned clay bricks should be used for all brick masonry work.

Traditional bricks of size 24 x12 x 6 cm should be used.

Bricks should be free from saline deposits, be regular and uniform in size with sharp square edges and parallel faces.

Bricks shall be homogenous in texture and shall emit a clear metallic ringing sound when struck one against the other.

All brick used shall be free from cracks, chips, flaws and other blemishes.

Mortar materials
Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.
- White cement: Iron salts content ≤ 1%.
- Off-white cement: Iron salts content ≤ 2.5%.
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.
Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts. River or pit sand should be sharp, angular, hard, clean uncoated particles free from clay and organic impurities.

Water: Water to be used for the mixing of mortar should be clean and free from oil, acid, alkali, salts, organic materials or other substances that are harmful to the mortar mix.

Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

**Mortar**

Ratio of mix for brick masonry shall be 1:4, cement-sand.

Mortar joints shall not exceed 8mm in thickness; all joints shall be fully filled with mortar.

All sand and cement for mortar shall be mixed in the correct proportion by the use of:

a. Wooden box.
b. Bucket, plastic or steel.

All sand and cement for brick masonry shall be fully mixed prior to the addition of water on a waterproof surface. The mortar shall be fully mixed by turning at least 3 times following addition of the water.

Every course of brickwork shall be horizontal and the resulting constructed wall shall be vertical.

Under no circumstances will vertical joints in consecutive layers of brickwork be accepted.

No broken or damaged bricks are to be incorporated into the masonry.

Bricks shall be laid with the frog facing upwards, except for the final (top) course which shall be laid with the frog facing down.

Brickwork constructed during the course of one shift (8 hours) shall not exceed 1m in height.

When stopping incomplete brickwork, the bricks shall be stepped at an angle not to exceed 45°.

All joints shall be raked and the brickwork faces cleaned at the end of each shift (8 hours).

All brickwork is to be kept wet for a period of not less than 10 days following its construction. At the end of each shift the top of all brickwork being cured is to be flooded with water.

**Mortar for Masonry Plaster**

Ratio of mix for plaster mortar shall be 1:2:9, cement-lime-sand.

All sand, lime and cement for plaster mortar shall be mixed in the correct proportion by the use of:

a. Wooden box.
b. Bucket, plastic or steel.
All sand, lime and cement for plaster masonry shall be fully mixed prior to the addition of water on a
water proof surface. The mortar shall be fully mixed by turning at least 3 times following addition of the
water.

Plaster mortar is to be applied in layers not to exceed 12mm in thickness.

The finished face of plaster work is to be straight, fair and vertical.

Cement

The cement to be used in the work should be ordinary Portland cement complying with ASTM C-150
or BS-12.

All cement should be protected from moisture and
damage in transit any deteriorated or hardened cement will not be permitted in the works and is to be
removed from site at the contractors’ expense.

Sand

River or pit sand should be sharp, angular, hard, clean uncoated particles free from clay and organic
impurities.

Well graded sand must be used for all cement work. Sand required for brickwork must be finer than
that for stone work.

For ordinary masonry work, concrete and first coat of plaster, the sand should pass through a 2.00
mm sieve.

Aggregates

Aggregates must be clean and free from clay, loam, vegetable and organic material. A well graded
crushed rock or gravel that contains both sand and stones should be used for concrete work.

The size of aggregates should not be larger than 30 mm.

The aggregates should be washed at least once in clean water immediately before being used in
concrete production.

2.2 COMPONENTS

Nailing blocks
Solid timber, or hollow timber box filled with earthen mortar. Timber unseasoned or thoroughly pre-
wetted.

Steel components, including reinforcement
All steel components to be galvanised for maximum durability after incorporation into the structure.

Window and Door lintels
Lintels: Use steel, concrete or timber lintels in accordance with the manufacturers’ technical literature
or conform to the Steel angle and T-lintels table.
Steel angle and T-lintels table

<table>
<thead>
<tr>
<th>Maximum span (mm)</th>
<th>Wall height above ≤ 600 mm</th>
<th>Wall height above &gt; 600 mm, ≤ 1800 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Angle lintel size</td>
<td>T-Lintel dimensions: H x W x T (mm)</td>
</tr>
<tr>
<td>1000</td>
<td>Two 75 x 50 x 5 Unequal angles</td>
<td>81 x 150 x 6</td>
</tr>
<tr>
<td>2000</td>
<td>Two 100 x 75 x 6 Unequal angles</td>
<td>136 x 150 x 6</td>
</tr>
<tr>
<td>2400</td>
<td>Two 125 x 75 x 8 Unequal angles</td>
<td>156 x 150 x 6</td>
</tr>
<tr>
<td>2800</td>
<td>Two 150 x 90 x 8 Unequal angles</td>
<td>158 x 150 x 8</td>
</tr>
<tr>
<td>3000</td>
<td>Two 150 x 90 x 10 Unequal angles</td>
<td>160 x 150 x 10</td>
</tr>
</tbody>
</table>

Timber lintels
Size: Width of the wall and in conformance with the Timber lintels height table.
Grade: Best quality of imported Russian timber or suitable approved local timber.
Bearing: 300 mm (minimum).

Timber lintels height table

<table>
<thead>
<tr>
<th>Maximum span (mm)</th>
<th>Lintel height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>150</td>
</tr>
<tr>
<td>1800</td>
<td>150</td>
</tr>
<tr>
<td>2400</td>
<td>200</td>
</tr>
<tr>
<td>3000</td>
<td>250</td>
</tr>
</tbody>
</table>

Timber fixing plates
Size: 200 x 50 mm (minimum).

Holding-down bolts
Type: 10 mm diameter threaded rod.
Termination: Horizontal 5 x 100 x 200 mm steel plate, weld-fixed, or with nuts.
Depth of embedment:
- Length (minimum): 450 mm.

3 EXECUTION

3.1 GENERAL

General
Construction of masonry brickwork shall not commence until the Engineer has accepted the footings on which it is to be placed.
Brickwork shall be built plumb, curved or battered as shown on the Drawings or as may be required, by skilled masons and properly supervised workmen. Bricks shall be clean and if necessary, they shall be scrubbed. Bricks shall be soaked in water for at least one hour before use.
Unless otherwise specified bricks shall be laid in English Bond, with frogs downward. All horizontal joints shall be parallel and level. Vertical joints in alternate courses shall come directly over one another. Joint thickness shall be 6mm and shall in no case exceed 8mm. The height of four courses
including 4 bed joints shall rise 300mm. Set out brickwork with joints of uniform width and minimise cutting of masonry units.

Walls shall always be carried up regularly along their entire length unless otherwise directed by the Engineer.

**Mortar mix**
Mortar mixing shall be done in a mechanical mixer unless the Engineer specifically permits hand mixing. If hand-mixing is done, the operation shall be carried out on a clean watertight platform and cement & sand shall be first mixed dry in the required proportion to obtain a uniform color and then the mortar shall be mixed for at least two minutes after addition of water.

Cement Mortar shall be mixed in such quantities as can be used in the work within 30 minutes. Mortar, which has taken initial set, shall not be used, nor shall it be re-mixed with fresh mortar.

Preparing lime putty:
- Using hydrated lime: Add lime to water in a clean container and stir to a thick creamy consistency. Leave undisturbed for at least 16 hours. Remove excess water and protect from drying out.
- Using quicklime: Run to putty as soon as possible after receipt of quicklime. Partly fill clean container with water, add lime to half the height of the water, then stir and hoe ensuring that no lime remains exposed above the water. Continue stirring and hoeing for at least 5 minutes after all reaction has ceased, then sieve into a maturing bin. Leave undisturbed for at least 14 days. Protect from drying out.

Mortar proportions (cement:lime:sand): As defined on the drawings.

Sand stockpile: Ensure sand is dry and stored undercover to avoid errors in volume batching during the mixing process.

**Protection from contamination**
Protect masonry materials and components from ground moisture and contamination.

**Building in**
Embedded items: Build in fixing blocks, brackets, lintels and accessories as the construction proceeds.

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

**Joining to existing**
If jointing to existing work is required, provide a straight joint. Do not tooth new masonry into existing work.

**Chasing**
Chasing of brickwork shall be to the **Brickwork chasing table** and subject to the following limitations:
- Parallel chases on opposite faces of a wall shall not be closer than 600 mm to each other.

<table>
<thead>
<tr>
<th>Brick thickness (mm)</th>
<th>Depth of chase (maximum mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 250 thick</td>
<td>35</td>
</tr>
<tr>
<td>250 thick</td>
<td>25</td>
</tr>
<tr>
<td>100 thick non load bearing walls only</td>
<td>20</td>
</tr>
</tbody>
</table>

**Joint finish**
Lay brickwork on a full bed of mortar. Fill perpends solid.

Finish:
- Externally: Tool to give a dense water-shedding finish for face brickwork or rake not more than 10mm to give a key for render finish.
- Internally: If wall is to be plastered, rake not more than 10 mm to give a key.
Temporary support
If the final stability of the brickwork or blockwork is dependent on structural elements to be constructed after the brickwork, provide proposals for temporary support or bracing for the approval of the Engineer.

3.2 FACEWORK

Cleaning
General: Clean progressively as the work proceeds to remove mortar smears, stains and discolouration.

Colour mixing
Evenly distribute the colour range of units and prevent colour concentrations and “banding” unless specifically identified as a feature of the brickwork.

3.3 DAMP-PROOF COURSES

Damp-proof courses
Material: Embossed Polythene sheeting. Install sheeting at base of all walls to stop moisture rising up wall structures.

Location
Provide damp-proof courses as follows:
- Walls built off slabs on ground: In the bottom course of the wall on top of the slab.
- Walls adjoining infill floor slabs: In the course above the slab. Project 40 mm and dress down over the membrane turned up against the wall.

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

3.4 CONTROL OF MOVEMENT

Joints
Provide joints as follows:
- Expansion joints for brickwork:
  - Maximum length of continuous wall face: 8 m.
  - Closest joint location to external corner: 2.5 m.
  - Maximum vertical spacing: 8 m.
  - Width of control joint: ≥ 10 mm ≤ 20 mm.
  - Width of horizontal joint: ≥ 15 mm ≤ 20 mm.
Filler material: Provide compatible sealant and bond breaking backing materials which are non-staining to masonry.
- Bond breaking materials: To be non-adhesive to sealant, or faced with a non-adhering material.
- Foamed materials: To be closed-cell or impregnated, not water-absorbing.

Joint filling:
- Installation: Clean the joints thoroughly and insert an easily compressible backing material before sealing.
- Sealant depth: Fill the joints with a gun-applied flexible sealant for a depth of at least two-thirds the joint width.

Refer to the BOQ and drawings for details of locations, types and extent of built in components.
3.6 STONEWORK

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- The prepared stone sample range.
- Lintels in position.
- Damp proof courses in position.

1.2 TOLERANCES

Dimensions of stone units
Maximum deviation from required dimensions:
- Loadbearing stone in cut blocks: ± 4 mm.
- Other stone used in foundations or not exposed to view: No size requirement unless noted otherwise in this worksection.

2 PRODUCTS

2.1 NATURAL STONE

Stone types
Sandstone defects: Minor shale laminates and minor concentrations of carbonaceous material (tea leaves) are acceptable in visible faces. Neither defect is acceptable in carved or moulded work.
Granite defects: Igneous stone (e.g. granite) obtained from quarry stone extracted in blocks sufficiently large to suit the project requirements, and containing no more than a small degree of microcracking.

Stone selection
Grading: Select stone of the designated quality grade.
Matching: Within each grade, select stone for the best match of colour and pattern.

Source of stone supply
Ensure the stone quarry or supplier can provide all stone required for the project without the need to find alternative supplies.

2.2 MORTAR

Mortar materials
Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.
- White cement: Iron salts content ≤ 1%.
- Off-white cement: Iron salts content ≤ 2.5%.

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.

Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts. River or pit sand should be sharp, angular, hard, clean uncoated particles free from clay and organic impurities.

Water: Water to be used for the mixing of mortar should be clean and free from oil, acid, alkali, salts, organic materials or other substances that are harmful to the mortar mix.

Crushed stone: Fine aggregate consisting partly or wholly of crushed stone, made from material of the same type as the stone facing.
Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

**Mortar**
Standard and ratio of mix for all mortar shall be M-400 (1:3), M-300 (1:4), M-250 (1:5) and M-200 (1:6). Provide minimum water.

**Mortar mix**
Mortar mixing shall be done in a mechanical mixer unless the Engineer specifically permits hand mixing. If hand-mixing is done, the operation shall be carried out on a clean watertight platform and cement & sand shall be first mixed dry in the required proportion to obtain a uniform color and then the mortar shall be mixed for at least two minutes after addition of water.

Cement Mortar shall be mixed in such quantities as can be used in the work within 30 minutes. Mortar, which has taken initial set, shall not be used, nor shall it be re-mixed with fresh mortar.

Preparing lime putty:
- Using hydrated lime: Add lime to water in a clean container and stir to a thick creamy consistency. Leave undisturbed for at least 16 hours. Remove excess water and protect from drying out.
- Using quicklime: Run to putty as soon as possible after receipt of quicklime. Partly fill clean container with water, add lime to half the height of the water, then stir and hoe ensuring that no lime remains exposed above the water. Continue stirring and hoeing for at least 5 minutes after all reaction has ceased, then sieve into a maturing bin. Leave undisturbed for at least 14 days. Protect from drying out.

Mortar proportions (cement:lime:sand): As defined on the drawings.

Sand stockpile: Ensure sand is dry and stored undercover to avoid errors in volume batching during the mixing process.

3  **EXECUTION**

3.1  **WORKMANSHIP GENERALLY**

**Cutting**
Perform the necessary cutting and shaping of stone to designated profiles including weathering, jointing, chasing, forming grooves. Make the bed, face and back joints of the stone square and true where dimensioned stone is required.

**Carving and moulding**
Achieve a clean sharp finish. Carry out all work identified on the drawings to the approval of the Engineer.

3.2  **LAYING UNITS**

**Bedding**
Remove dust and foreign material from the bedding surfaces. Water the face of the stone units so that full strength joints are achieved. Where possible, bed and joint the stone in one operation. Lay each stone on a full bed of mortar. Solidly fill and grout vertical joints as the work proceeds. Point up joints around flashings as necessary.

**Natural bed**
Lay loadbearing sedimentary stone with its natural bed at 90 degrees to the load, except for the following:
- Cladding panels: In non-loadbearing cladding panels, form each panel with its natural bed at right angles to the face.

**Temporary support**
Provide support as necessary to the stone while the mortar is curing, using bracing, joint spacers, or both.

Bracing and joint spacers: Non-damaging and non-staining softwood wedges soaked in water. Do not allow metal pinch bars to bear directly on the stone.
Raking and toothing
Raise advanced work no more than 1.5 m above the general level, and rake back. Do not tooth stonework for subsequent additions except where toothing is shown on the drawings.

Bonding
Bond the masonry so as to provide stability and monolithic structural action to the stonework assembly.

3.3 STONE FOUNDATIONS

Stone footings
Construct the footing course entirely of through stones, and if stepping is necessary, overlap the stepped courses at least 300 mm.

Subfloor stone foundation walls
Minimum foundation wall thicknesses:
- Supporting masonry walls 100 mm thick: 300 mm.
- Supporting masonry walls 250 mm thick: 450 mm.
- Supporting masonry walls 370 mm thick: 600 mm.

Stone sizes:
- Maximum height: 350 mm.
- Minimum height: Generally 175 mm; through stones 300 mm.

Bond pattern: Provide through stones as follows:
- All stones in top and bottom courses.
- Elsewhere as header units.

Slab bearings: Provide continuous bearing at least 100 mm wide to the edge of suspended slabs.

3.4 DAMP-PROOF COURSES

Material
Material: Embossed Polyethylene sheeting. Install sheeting at base of all walls to stop moisture rising up wall structures.

Location
Provide damp-proof courses as follows:
- Walls built off slabs on ground: In the bottom course of the wall on top of the slab.
- Walls adjoining infill floor slabs: In the course above the slab. Project 40 mm and dress down over the membrane turned up against the wall.

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

3.5 JOINTING AND POINTING

Joints
Size (mm): Not less than 3mm or more than 5mm for dimensioned stonework. Size may vary for non dimensioned stonework from 10mm to 30mm. Joint size should not exceed this without approval of the Engineer.

Jointing material: Mortar with a strength less than the stonework. Lime putty where identified on drawings for special dimensioned stonework.

Pointing material: Coloured mortar or mortar as above, refer to Schedule or drawings. Lime putty where identified on drawings for special dimensioned stonework.

3.6 SEALANT JOINTING

Preparation for jointing
Immediately before jointing remove loose particles from the joint, using brushes or compressed air.
**Taping**
Protect the stonework surface on each side of the joint using 50 mm wide masking tape or equivalent means. On completion of pointing remove the tape and remove any stains or marks from the stonework surface.

**Jointing materials**
Use recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces.

Priming: Apply the recommended primer to the surfaces in contact with sealant materials.

Sealant colour: Refer to Schedule or drawings.

Foamed materials (in compressible fillers and backing rods): Closed cell or impregnated types which do not absorb water.

**Sealant application**
Apply the sealant to dry joint surfaces. Do not apply the sealant in unsuitable weather conditions (e.g. when the ambient temperature is outside the range 5 – 50°C) or outside the recommended working time for the material or the primer.

**Joint finish**
General: Produce a smooth, slightly concave surface using a tool designed for the purpose.

### 3.7 COMPLETION

**Cleaning**
Cleaning: Leave the stonework clean on completion.

Refer to the BOQ and drawings for details of locations, types and extent of built in components.
3.7 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.
3.8 STEELWORK PAINTING

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 drawings or manufacturer recommendations.

**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.
3.9 LIGHT TIMBERWORK

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 alloy 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.

3 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 $\geq 3000$ 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.
4.1 WATERPROOFING

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.
4.2 ROOFING

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of:
- Roof framing during construction.
- Those parts of the roofing, vapour barrier, insulation and roof plumbing installation which will be covered up or concealed.

1.2 SUBMISSIONS

Samples
Submit samples of the following showing the range of variation available:
- Currugated and flat metal roof sheeting
- Roof cappings, flashings, gutters, downpipes

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Fasteners
Self-drilling screws: Corrosion resistant screws to approval of Engineer.
Nuts and bolts: Corrosion resistant fastenings to approval of Engineer.
Fastenings to timber battens or purlins: Provide fastenings just long enough to penetrate the thickness of the timber without piercing the underside.

2.2 CORRUGATED METAL ROOFING AND CLADDING

General
Provide a proprietary system of preformed corrugated sheets and all purpose-made accessories required to complete the installation to roof framing or wall framing. Refer to detailed drawings for details.

2.3 FLAT SHEET METAL ROOFING AND CLADDING

General
Provide a system of flat metal sheets and all purpose-made accessories required to complete the installation to roof framing or wall framing.

2.4 GLAZED ROOFING AND SKYLIGHTS

General
Provide a proprietary overhead glazing system fixed to glazing bars or directly to the roof framing. Provide all purpose-made accessories required to complete the installation.

2.5 ROOF VENTILATORS

General
Provide proprietary roof mounted ventilators and all purpose-made accessories required to complete the installation where shown on the drawings to ventilate the roof space.
Provide fabricated ventilators in walls as shown on the drawings to ventilate the roof space.
3 EXECUTION

3.1 INSTALLATION

Protection
Keep the roofing and rainwater system free of debris and loose material during construction, and leave them clean and unobstructed on completion. Repair damage to the roofing and rainwater system.

If it is necessary to repair minor damage to metal roofing, do so immediately after the damage has occurred. The Contractor is to take care to not damage other surfaces during the repair works.

Thermal movement
Provide for thermal movement in the roof installation and the structure, including movement in joints and fastenings.

3.2 SHEET METAL ROOFING AND CLADDING

Roofing sheet installation
Fixings: Provide all fixings required to fix the roof sheeting to the framing so that the entire roof covering is waterproof and secure. All loose edges are to be fixed down to ensure that they cannot get loose in high winds.

Expansion joints: refer to drawings for locations of expansion joints in roofs and details of construction.

Ridges and eaves
Treat ends of sheets as follows:
- Project sheets 50 mm into gutters.
- Close off ribs of ribbed sheeting at bottom of sheets using mechanical means or with purpose-made end caps.
- Turn pans of ribbed sheeting up at tops and down into gutters by mechanical means.
- Provide pre-cut notched eaves flashings and birdproofing wire mesh where necessary.

Ridge and eaves capping
Finish off along ridge and side eaves edges with purpose-made ridge capping and eaves cappings.

End laps
Where end laps are unavoidable in roof sheeting, and the sheet profile is not suitable for interlocking or contact end laps, construct a stepped type lap. Refer to details on drawings as required.

Length of lap (mm): Laps to ends of sheets should not be less than 150mm and sealed with a continuous line of silicone sealant between the sheets of roofing.

Curved corrugated sheet
Form by rolling from material recommended for curving. Minimise crimping or creasing across the face of the sheet. Trim off crimped or creased edges and ends.

K-Span roofing where identified on the drawings is to be strictly controlled during the installation process to ensure that the completed work is of a high standard.

Cladding sheet installation
Fixings: Provide all fixings required to fix the wall cladding sheeting to the framing so that the entire wall is waterproof and secure. All loose edges are to be fixed to ensure that they cannot get loose in high winds.

Expansion joints: refer to drawings for locations of expansion joints in walls and details of construction.

Flashings: Flashings are required at the top, sides and bottom of all metal wall cladding to ensure that the wall is waterproof in all weather conditions.

Metal separation
Prevent direct contact between incompatible metals, and between green hardwood and aluminium or coated steel, by either:
- Applying an anti-corrosion, low moisture transmission coating to contact surfaces.
- Inserting a separation layer.

### 3.3 GLAZED ROOFING AND SKYLIGHTS

**Installation**

Fixing: Fix all glazed roof panels and skylights in accordance with the drawings.

Flashings: Flashings are required at the top, sides and bottom of all glazed roof panels and skylights to ensure that the roof is waterproof in all weather conditions.

### 3.4 ROOF VENTILATORS

**Installation**

Fixing: Fix roof ventilators in accordance with the manufacturers construction details or in accordance with the drawings for fabricated ventilators.

### 3.5 ROOF PLUMBING

**General**

Provide the flashings, cappings, gutters, rainwater heads, outlets and downpipes necessary to complete the roof system.

**Jointing sheet metal rainwater goods**

Butt joints: Make joints over a backing strip of the same material.

Soldered joints: Do not solder aluminium or aluminium/zinc-coated steel.

Sealing: Seal fasteners and mechanically fastened joints. Fill the holes of blind rivets with silicone sealant.

**Flashings and cappings**

Installation: Flash roof junctions, upstands, abutments and projections through the roof. Preform to required shapes where possible. Cut, notch, bend or dress down as necessary to follow the profile of adjacent surfaces. Lap joints 150 mm in running lengths. Provide matching expansion joints at 6 m maximum intervals.

Upstands: Flash projections above or through the roof with two part flashings, consisting of a base flashing and a cover flashing, with at least 100 mm vertical overlap. Provide for independent movement between the roof and the projection.

Wall abutments: Provide overflashings where roofs abut walls, stepped to the roof slope in brickwork.

- In masonry: Build cover flashing at least 100mm into the wall at least 250mm above the roof level. Provide base flashing on roof and provide at least 100mm vertical overlap.
- In concrete: Turn cover flashing at least 30 mm into sawcut grooves at least 250mm above the roof level, wedge at 200 mm centres with compatible material and render over top of flashing. Provide base flashing on roof and provide at least 100mm vertical overlap.

Fixing to pipes: Solder, or seal with neutral cured silicone rubber and either of the following:

- Secure with a clamping ring.
- Provide a proprietary flexible clamping shoe with attached metal surround flashing.

**Gutters**

Prefabricate gutters to the required shape where possible. Form stop ends, bends and returns. Provide overflows to prevent back-flooding.

Gutter and sump support: Provide framing and lining to support valley gutters, box gutters and sumps. Line the whole area under the gutters and sumps.

Support: Steel straps as shown on drawings or as approved by the Engineer.

Lining: Timber boards or plywood as shown on drawings or as approved by the Engineer.

Valley gutters: Profile to suit the valley boarding. Nail or screw to the valley boarding at the top end to prevent the gutter creeping downwards.

Gratings and guards: Provide removable gratings over rainwater heads and sumps:

- Type: Wire mesh cages reinforced with steel bars where required due to size and expected snow loads. Refer to drawings for details.

Expansion joints: Provide expansion joints in guttering longer than 30 m:
- Type: Refer to drawings for details.

**Downpipes**
Prefabricate downpipes to the required section and shape where possible. Connect heads to gutter outlets and, if applicable, connect feet to rainwater drains.

Access cover: Provide a removable watertight access cover at the foot of each downpipe stack if the downpipe is connected to rainwater drains.

Downpipe support: Provide supports and fixings for downpipes.

### 3.6 ROOF MOUNTED EQUIPMENT ACCESS

**Walkway**
Product: Provide proprietary walkway system to locations as shown on drawings. Provide fabricated system constructed as shown on drawings. Fabricate in accordance with metalwork section of the specification.

Installation: Install proprietary systems in accordance with manufacturers details and as identified on drawings.

### 3.7 COMPLETION

**Roof Inspection**
The Contractor is to closely inspect the entire roof covering and metal cladding to walls at completion of the works.

Make good any defects or damage to the sheeting, cappings or flashings. Remove all loose metal and other rubbish, spare nails, screws, filings and other debris.

Clean down the roof, gutters, downpipe outlets to ensure that it is good condition ready for occupation.
4.3 WINDOWS AND WINDOW HARDWARE

1 GENERAL

1.1 INTERPRETATION

Definitions
For the purposes of this worksection windows also includes louvres, either vertical or horizontal, set into frames.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Openings prepared to receive windows (where windows are to be installed in prepared openings).
- Fabricated window assemblies delivered to the site, before installation.
- Commencement of window installation.

2 PRODUCTS

2.1 LOUVRE ASSEMBLIES

General
Provide louvre blades mounted in a surround frame and able to withstand the wind pressure for that location without failure or permanent distortion of blades, and without blade flutter.

Adjustable louvres
Provide louvre blades clipped into holders which pivot, linked together in banks, each bank operated by an operating handle incorporating a latching device, or by a locking bar.

Screens
Provide metallic coated steel wire mesh screens behind louvres to prevent the entry of birds, rodents and wind blown leaves and papers.

2.2 INSECT SCREENS

Aluminium framed screens
Provide insect screens with mesh frame channel. Provide an extended frame section where necessary to adapt to window opening gear.
- Mesh: Fix the mesh into the frame channel with a continuous resilient gasket, so that the mesh is taut and without distortion.

Fixed screens
Provide fixed screens to the window frames with a clipping device which permits removal for cleaning.

Hinged screens
Hinge at the side to give access to opening sash.

Sliding screens
Provide a matching aluminium head guide, sill runner, and frame stile sections for screens not part of the window frame.
- Hardware: Nylon slide runners and finger pull handle.

2.3 SECURITY WINDOW GRILLES

General
Provide security grilles in accordance with the drawings or proprietary metal security grille screens, fixed to the building structure with tamper resistant fastenings.
2.4 WINDOW HARDWARE

Hardware
Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use and climate and fabricated with fixed parts firmly joined.

3 EXECUTION

3.1 INSTALLATION

General
Install windows so that the frames:
- Are plumb, level and straight within acceptable building tolerances.
- Are fixed or anchored to the building structure to resist the wind loading.
- Will not carry any building loads, including loads caused by structural deflection.
- Allow for thermal movement.

Flashing and weatherings
Install moulds, sealant and cement pointing as required so that water is prevented from penetrating the building between the window frame and the building structure.

Fixing and fasteners
Materials: Use materials compatible with the item being fixed and of sufficient strength, size and quality to perform their function.
Concealed fixings: Provide a corrosion resistant finish.
Exposed fixings: Match exposed fixings to the material being fixed.
Support: Provide appropriate back support (for example blocking and backing plates) for hardware fixings.
Window fastener spacing (nominal): 600 mm.
Window fasteners: Conceal fasteners where possible.
Packing: Pack behind fixing points with durable full width packing.
Prepared masonry openings: If fixing timber windows into existing prepared openings with fastenings through the frame face, make the fastener heads finish below the surface and fill the hole for a smooth surface finish.

Joints
Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Operation
Ensure moving parts operate freely and smoothly, without binding or sticking and are lubricated.

Supply
Deliver window hardware items, ready for installation, in individual complete sets for each window.
- In a separate dust and moisture proof package labelled for the specific window.
- Including the necessary templates, fixings and fixing instructions.
Refer to the drawings for details of windows and for details of window hardware.

3.2 COMPLETION

Cleaning
The Contractor is to clean all frames, glass, hardware at completion. Any damage to frames, or broken glass is to be repaired or replaced to the satisfaction of the Engineer.

Adjustment
Leave the hardware properly adjusted with working parts in working order and lubricated where appropriate.
1 GENERAL

1.1 INTERPRETATION

Definitions
For the purposes of this worksection the definitions given below apply.
- Door frame: Includes door trims.
- Doorset: An assembly comprising a door or doors and supporting frame, guides and tracks including the hardware and accessories necessary for operation.
  - Fire-doorset: A doorset which retains its strength and limits the spread of fire.
  - Smoke-doorset: A doorset which restricts the movement of smoke.
- Flush door: A door leaf having two flat faces which entirely cover and conceal its structure. It includes doors with cellular and particleboard cores.
- Joinery door: A door leaf having stiles and rails, framed together. A joinery door may also incorporate glazed panels.
  - Louvre door: A joinery door in which the panel spaces are filled in with louvre blades.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Door frames standing in place before building in to brickwork.
- Door frames installed before fixing trim.

1.3 SUBMISSIONS

Samples
Submit samples of all hardware items for approval by the Engineer before use in the works.

Subcontractors
Automatic sliding door assemblies: Submit names and contact details of proposed supplier and installer.

Product warranties
Automatic sliding door assemblies: Submit a warranty from the supplier and installer for the system and its installation, for a period of at least twelve months from the date of completion.
Hardware: Submit the warranties offered by the manufacturer for the hardware items provided in the works.

Keys
Key codes: Submit the lock manufacturer’s record of the key coding system showing each lock type, number and type of key supplied, key number for re-ordering, and name of supplier.
Keys: For locks keyed to differ and locks keyed alike, verify quantities against key records, and deliver all keys and records to the Engineer at completion.

2 PRODUCTS

2.1 FRAMES

Aluminium frames
To be assembled from aluminium sections, including necessary accessories such as buffers, strike plates, fixing ties or brackets, and suitable for fixing specified hardware.
Timber frames
To be constructed with best quality timber. Obtain approval from the Engineer for the timber selection before use. Construct as shown on the drawings and ensure that all joints are securely made to avoid distortion of the frame in use.

Steel frames
To be folded from metallic-coated steel sheet sections, joints to be continuously welded, including necessary accessories such as buffers, strike plates, spreaders, fixing ties or brackets, and suitable for fixing specified hardware.

Finish: Grind the welds smooth, prepare and paint the welded joints with primer. Then prime the entire frame.

Hardware and accessories: Provide for fixing hardware including hinges and closers, using 4 mm backplates inside the frame. Screw fix the hinges into the back plates.

Base metal thickness:
- General: ≥ 1.1 mm.
- Fire rated doorsets: ≥ 1.4 mm.
- Security doorsets: ≥ 1.6 mm.

2.2 DOORS

Flush doors
Cellular core flush doors:
- Provide a subframe of 25 mm minimum width timber around openings for louvres and glazing.
- Provide additional material to take hardware and fastenings.
- Cut outs: If openings are required in flush doors (e.g. for louvres or glazing) make the cut outs not closer than 120 mm to the edges of the doors.

Solid core flush doors:
- Core of timber strips laid edge to edge, fully glued to each other and to facings each side of no less than two sheets of timber veneer.
- Single thickness of moisture resistant general purpose particleboard.

Refer to drawings for details.

Joinery doors
Fabricate joinery doors as shown on the drawings.

Construction
Form rebates to suit standard rebated door hardware.

Louver grilles: Construct by inserting the louver blades into a louver frame, and fix the frame into the door.

Double doors
Provide rebated meeting stiles unless the doors open in both directions. Chamfer square edged doors to prevent binding between the leaves.

2.3 DOORSETS

Automatic sliding door assemblies
Provide auto sliding door assemblies in accordance with the drawings.

Toughened glass door assemblies
Provide toughened glass door assemblies with matching concealed hinges and patch fittings as appropriate. Ensure that all glass edges are protected during installation and polish on completion.

Fire-resistant doorsets
Provide fire resistant doors and frames as matched sets for door openings required to have a fire rating.

Provide copies of test certificates from recognised authorities proving the performance of the doorsets.
Smoke-resistant doorsets
Provide smoke resistant doors and frames as matched sets for door openings required to have a smoke stopping capability.
Provide copies of test certificates from recognised authorities proving the performance of the doorsets or seals to frames.

Security screen doorsets
Provide security screen doorsets in accordance with the drawings.

2.4 ANCILLARY MATERIALS

Nylon brush seals
To be dense nylon bristles locked into galvanized steel strips and fixed in a groove in the edge of the door or in purpose-made anodised aluminium holders fixed to the door.

Pile weather strips
To be polypropylene or equivalent pile and backing, low friction silicone treated, ultra-violet stabilised.

Door Seals
To be proprietary items as identified in drawings and to approval of Engineer.

2.5 HINGES

Butt hinge sizes
Refer to Hinge table A and Hinge table B in which length (l) is the dimension along the knuckles, and width (w) is the dimension across both hinge leaves when opened flat.
- Steel, stainless steel, brass, bronze butt hinges for timber doors in timber or steel frames: To Hinge table A.
- Aluminium hinges for aluminium doors, or for doors of other materials in aluminium frames: To Hinge table B.

Hinge materials
Aluminium hinges: High tensile aluminium with fixed stainless steel pins in nylon bushes, and with nylon washers to each knuckle joint.
Doors fitted with closers: Provide low friction bearing hinges.

Hinge pins
Exterior or security doors opening out: Provide fixed pin hinges.

Hinge table A

<table>
<thead>
<tr>
<th>Nominal hinge size l x w x t (mm)</th>
<th>Door leaves not exceeding any of the following</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mass (kg)</td>
</tr>
<tr>
<td>70 x 50 x 1.6</td>
<td>16</td>
</tr>
<tr>
<td>85 x 60 x 1.6</td>
<td>20</td>
</tr>
<tr>
<td>100 x 75 x 1.6</td>
<td>30</td>
</tr>
<tr>
<td>100 x 75 x 2.5</td>
<td>50</td>
</tr>
<tr>
<td>100 x 75 x 3.2</td>
<td>70</td>
</tr>
<tr>
<td>125 x 100 x 3.2</td>
<td>80</td>
</tr>
</tbody>
</table>

Hinge table B

<table>
<thead>
<tr>
<th>Nominal hinge size l x w x t (mm)</th>
<th>Door leaf not exceeding mass (kg)</th>
<th>Minimum construction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Knuckles</td>
</tr>
<tr>
<td>100 x 70 x 3</td>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>100 x 80 x 3.5</td>
<td>50</td>
<td>5</td>
</tr>
</tbody>
</table>
Number of hinges
Provide 3 hinges for doors up to 2200 mm high, and 4 for door leaves between 2200 mm and 3000 mm high.

Wide throw
If necessary, provide wide throw hinges to stop doors binding on obstacles such as nibs or deep reveals.

2.6 DOOR HANGING SYSTEMS

General
Provide sliding door tracks in conformance with the drawings.

2.7 LOCKS AND LATCHES

General Door Hardware
Provide hardware of sufficient strength and quality to perform its function, appropriate to the intended conditions of use and climate and fabricated with fixed parts firmly joined.

Bolts
Provide bolts including barrel bolts and tower bolts with associated hardware, including lock plates, ferrules or floor sockets.

Furniture
Provide lock and latch furniture suitable for use with the lock or latch to which it is installed with the corresponding level of performance.

Strike plates
Use strike plates provided with the locks or latches.

Fire rated door closers
Provide closers tested and certified for use as components of fire door assemblies.

Door Controllers Performance
Provide door controllers, including door closers, floor or head spring pivots which are suitable for the door type, size, weight and swings required and the operating conditions, including wind pressure.

3 EXECUTION

3.1 FRAMES

General
Install doors so that the frames:
- Are plumb, level and straight within acceptable building tolerances.
- Are fixed or anchored to the building structure to resist the wind loading.
- Will not carry any building loads, including loads caused by structural deflection.
- Allow for thermal movement.

Flashing and weatherings
Install moulds, sealant and cement pointing as required so that water is prevented from penetrating the building between the door frame and the building structure.

Aluminium frames
Building in to masonry: Screw galvanized steel brackets twice to jambs and build in.
Fixing to masonry openings: Use proprietary expansion anchors and screw through jambs at each fixing.

Frame fixing
Brackets: Metallic-coated steel:
- Width: ≥ 25 mm.
- Thickness: ≥ 1.5 mm.
Jamb fixing centres: ≤ 600 mm.
Fixing and fasteners
Materials: Use materials compatible with the item being fixed and of sufficient strength, size and quality to perform their function.
Concealed fixings: Provide a corrosion resistant finish.
Exposed fixings: Match exposed fixings to the material being fixed.
Support: Provide appropriate back support (for example blocking and backing plates) for hardware fixings.
Packing: Pack behind fixing points with durable full width packing.
Prepared masonry openings: If fixing timber door frames into existing prepared openings with fastenings through the frame face, make the fastener heads finish below the surface and fill the hole for a smooth surface finish.

Joints
Make accurately fitted tight joints so that neither fasteners nor fixing devices such as pins, screws, adhesives and pressure indentations are visible on exposed surfaces.

Operation
Ensure moving parts operate freely and smoothly, without binding or sticking and are lubricated.

Supply
Deliver door hardware items, ready for installation, in individual complete sets for each door.
- In a separate dust and moisture proof package labelled for the specific door.
- Including the necessary templates, fixings and fixing instructions.

3.2 COMPLETION

Cleaning
The Contractor is to clean all frames, doors, glass, hardware at completion. Any damage to frames and doors, or broken glass is to be repaired or replaced to the satisfaction of the Engineer.

Adjustment
Leave the hardware properly adjusted with working parts in working order and lubricated where appropriate.
4.5 GLAZING

1 GENERAL

1.1 INSPECTION

Notice
Inspection: Give sufficient notice so that inspection may be made of the following:
- Glass products before they are installed.

2 PRODUCTS

2.1 GLASS

Glass and glazing materials generally: Free from defects which detract from appearance or interfere with performance under normal conditions of use.

Glazing plastics: Free from surface abrasions, and warranted by the manufacturer for 10 years against yellowing or other colour change, loss of strength and impact resistance, and general deterioration.

2.2 GLAZING MATERIALS

General
Glazing materials (including putty, glazing compounds, sealants, gaskets, glazing tapes, spacers, setting blocks): Appropriate for the conditions of application and the required performance.

Jointing materials
Provide recommended jointing and pointing materials which are compatible with each other and with the contact surfaces and non staining to finished surfaces. Do not provide bituminous materials on absorbent surfaces.

Pile weather strips
Materials: Polypropylene or equivalent pile and backing, low friction silicone treated, ultra violet stabilised.

Finned type: A pile weather seal with a central polypropylene fin bonded into the centre of the backing rod and raised above the pile level.

Extruded gaskets and seals
Type: Non cellular (solid) seals to exclude water from glass/frame junctions.

Material:
- Rubber products to be neoprene, ethylene propylene diene monomer (EPDM) or silicone rubber.
- Flexible polyvinyl chloride (PVC)

Priming
Apply the recommended primer to the surfaces in contact with sealant materials.

Movement joints
Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Foamed materials (in compressible fillers and backing rods): Closed-cell or impregnated types which do not absorb water.

Bond breaking: Provide backing rods, and other back-up materials for sealants, which do not adhere to the sealant.

2.3 MIRRORS

Reflective surface
Type: Silver layer deposited on the glass or glazing plastic.
EXECUTION

3.1 GLASS PROCESSING

General
Perform required processes on glass, including cutting, obscuring, silvering and bending. Form necessary holes, including for fixings, equipment, access holes and speaking holes. Process exposed glass edges to a finish that will reduce the risk of injury.

3.2 INSTALLATION

General
Install the glass so that:
- Each piece is held firmly in place by permanent means which enable it to withstand the normal loadings and ambient conditions at its location without distortion or damage to glass and glazing materials.
- Building movements are not transferred to the glass.
- External glazing is watertight and airtight.

Toughened glass: Do not cut, work, or permanently mark after toughening. Use installation methods which prevent the glass making direct contact with metals or other non-resilient materials.

Frameless installations: Join the vertical edges of adjacent glass panels with silicone jointing compound.

External timber framed glazing: Glaze with putty. Do not dry bead into timber frames.

3.3 FIXING MIRRORS

Screw fixing
Direct to wall plugs with dome-headed chromium-plated screws in each corner and at 900 mm maximum centres around perimeter. Provide polyethylene sleeves and washers to prevent contact between screw and glass. Do not over-tension the screws.

Frame fixing
Proprietary aluminium frames to mirror perimeter, corners mitred. Attach the frame to the wall with concealed screw fixings. Frames and finish to approval of the Engineer.

Bead fixing
Rebated timber beads to mirror perimeter, corners mitred. Screw fix the beads to the substrate.

3.4 GLAZED SHOWER SCREENS

Type
Proprietary system comprising frames of extruded aluminium, stainless steel, or PVC, assembled around safety glass to form fixed panels and sliding, hinged or pivoted doors.

Water shedding
Provide an assembly which sheds water to the inside without retaining it on the frame surfaces. Seal the edge of the frame to adjoining surfaces with a resilient strip.

Sliding assemblies
Hanging: Hang the sliding sash on stainless steel or nylon sheaves on overhead channel track formed in the frame head, and fit nylon or equivalent bottom guides.
Hardware: Pull handles on both sides of sash, or of leading sash in multiple sash arrangements.

3.5 COMPLETION

Cleaning
Replace damaged glass and leave the work clean, polished, free from defects, and in good condition.
4.7 INSULATION AND VAPOUR BARRIERS

1 GENERAL

1.1 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.
- Sarking-type material: Flexible reflective foil membrane material normally used for waterproofing, vapour proofing or thermal reflectance.
- Mineral wool (including glasswool and rockwool): Entangled mat of fibrous non-crystalline material derived from inorganic oxides or minerals, rock, slag or glass, processed at high temperatures from a molten state.
- Vapour barrier: A material or system that adequately impedes the transmission of water vapour.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the insulation to roof space in areas which will be covered up or concealed.

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Bulk insulation
Mineral wool blankets and cut pieces: Provided in bulk rolls for laying over roof structures or on roof slabs and batts to suit ceiling member spacing.
Polystyrene (extruded rigid cellular sheets): Provided in modular panels for fixing to walls and roof slabs.
Reflective insulation: Provided in bulk foil rolls for laying over roof structures and foil batts to suit ceiling member spacing.

Sarking-type material
Sarking: Reflective foil fixed as a membrane to reduce liquid water transfer in walls or roof structures but allow water vapour to move through the building envelope.
Vapour barrier: Reflective foil sealed as a membrane to stop all liquid water and water vapour transfer.

Fasteners and supports
Metallic-coated steel.

3 EXECUTION

3.1 GENERAL

Bulk insulation
Batts: Fit tightly between framing members. If support is not otherwise provided, fix over wire mesh stapled to the framing and stretch tight.

Reflective foil laminate
To timber: Metallic-coated flat head nails or staples at 300 mm maximum centres.
To steel or aluminium: Double sided pressure sensitive tape.
Overlap (minimum): 150 mm and adhesive fix.
**Roof sarking locations**
Location: Provide sarking under metal sheet roofs. Fix over timber supports and run rolls across roof plane. Overlap each layer of foil so that any water will run down the slope and discharge into the gutter without dripping into the roof space.

**3.2 ROOF INSULATION**

**General**
Location: The whole of the ceiling area, except the following:
- Eaves, overhangs, rooflights, vents and openings.
- Roofs to outbuildings, garages, and semi-enclosed spaces such as verandahs, porches.

**Installation**
Refer to the drawings for details of insulation requirements for the works.
5.1 LINING

1 GENERAL

1.1 INSPECTION

Notice
Inspection: Give sufficient notice so that inspection may be made of the wall face or framing before installation of linings.

1.2 SUBMISSIONS

Samples
Plasterboard: Submit two 300x300mm samples of each type.
Fibre cement sheet: Submit two 300x300mm samples of each type.
Accessories: Submit samples of accessories, fasteners, trims and cornices.

1.3 TOLERANCES

Surface
Flatness, twist and bow: ≤ 3.0 mm deviation from a 1.5 m straightedge placed in any position.

2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

Plasterboard
Plasterboard sheet lining to be best quality imported sheet material, size, type and thickness in accordance with the drawings, to the approval of the Engineer.

Fibre cement
Fibre cement sheet lining to be best quality imported sheet material, size, type and thickness in accordance with the drawings, to the approval of the Engineer.

Fasteners
Steel nails: Hot dip galvanized.
Screws: Coated steel cross head screws.

Adhesives
For plasterboard: Epoxy grout adhesive as supplied by the plasterboard sheet manufacturers.
For cement sheet: Mastic adhesive.

Sealants
Fire rated sealant: Non-hardening sealant compatible with the materials to be sealed and having a fire rating equal to that of the partition it seals.
Acoustic sealant: Non-hardening sealant compatible with the materials to be sealed and having a specific gravity of not less than 1.5 gm/cubic centimetre and of 100% polyurethane mastic.

3 EXECUTION

3.1 CONSTRUCTION GENERALLY

Conditions
Do not commence lining work until such time as the building or zone in question is enclosed and weathertight and all wet trades have been completed.

Substrates or framing
Before fixing linings check and, if necessary, adjust the alignment of wall faces or framing. Make good any damaged areas that may affect the fixing of the lining. Ensure that there are no projections from the face of the wall structure that may affect the installation of the lining material.
Ceiling linings
Do not install ceilings until at least 14 days after the timber roof structure is fully loaded where this is used for support of the ceiling.

Accessories and trim
Provide accessories and trim necessary to complete the installation.

Adhesives
Provide adhesives of types appropriate to their purpose, and apply them so that they transmit the loads imposed, without causing discolouration of finished surfaces.

3.2 PLASTERBOARD LINING

Supports
Install timber battens or galvanized steel channels as follows:
- Where framing member spacing exceeds the recommended spacing.
- Where direct fixing of the plasterboard is not possible due to the arrangement or alignment of the framing or wall face.

Installation
Gypsum plasterboard: Install strictly in accordance with manufacturers recommendations.
Framed construction: Screw or nail or combine with adhesive.
Masonry construction: Fix using adhesive direct to masonry.
Suspended ceilings: Fix using screw or screw and adhesive to ceiling members.
To steel channels: Fix using screw or screw and adhesive.

Multiple sheet layers
Application: Fire rated and acoustic rated walls.
Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Joints
Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.
Butt joints: Make joints over framing members or otherwise provide back blocking.
External corner joints: Make joints over metallic-coated steel corner beads.
Control joints: Install purpose-made metallic-coated control joint beads at not more than 12 m centres in walls and ceilings and to coincide with structural movement joints.

3.3 FIBRE CEMENT LINING

Supports
Install timber battens or galvanized steel channels as follows:
- Where framing member spacing exceeds the recommended spacing.
- Where direct fixing of the fibre cement is not possible due to the arrangement or alignment of the framing or substrate.

Installation
Run sheets across the framing members. In flush jointed applications, stagger end joints in a brick pattern and locate them on framing members, away from the corners of large openings. Provide supports at edges and joints.
Timber framed construction: Nail only or combined with adhesive.
Steel framed construction: Screw only or combined with adhesive.
Masonry construction: Fix using adhesive direct to masonry.
Suspended flush ceilings: Fix using screw or screw and adhesive to ceiling members or support frame.
Ceilings and soffits: Provide battens where fixing to underside of rafters, roof trusses and purlins.

Multiple sheet layers
Application: Fire rated and acoustic rated walls.
Joints: Fill and flush up all joints and fixings in each layer and caulk up perimeters and penetrations before commencing succeeding layers. Stagger all sheet joints by minimum 200 mm.

Joints
Flush joints: Provide recessed edge sheets and finish flush using perforated paper reinforcing tape.
- Movement joints in walls: Position a stud parallel to the joint on each side.
- Movement joints in ceilings and soffits: Provide movement joints to divide ceilings into bays not larger than 10.8 x 7.2 m and soffit linings into bays not larger than 4.2 x 4.2 m or 5.4 x 3.6 m.
  Provide framing parallel to the joint on each side. Do not fix the lining to abutting building surfaces.
External corner joints: Make joints over metallic-coated steel corner beads.
Control joints: Provide purpose-made metallic-coated control joint beads at ≤ 7.2 m centres in walls and ceilings and to coincide with structural movement joints.

3.4 CEILING ACCESS

General
Location: Provide personnel access ways to each separate ceiling space.
Size (mm): Minimum of 600 x 600 mm
Material: Match adjacent ceiling lining.
Type: Plain cover supported on all sides by timber trim fixed to underside of ceiling.

3.5 CORNICES

General
Plasterboard cornice: Install plasterboard trims to the junctions between wall surfaces and ceilings as shown on the drawings.
Timber cornices: Install timber trims to the junctions between wall surfaces and ceilings as shown on the drawings.

3.6 COMPLETION

General
Ensure that all surfaces are protected, dry and free from damage until paint finishes are to be applied.
All plasterboard and fibre cement surfaces must dry for at least 7 days before painting is to commence.
5.2 PARTITIONS – SYSTEMS

1 GENERAL

1.1 INTERPRETATION

Definitions
For the purposes of this worksection the definitions given below apply.

- Partition – fully demountable: A partition system in which any component may be demounted without damage, using only small hand tools, and subsequently reassembled without cutting, trimming or refinishing.
- Partition – semi demountable: A partition system in which the major components are designed to be removed and reused but panels or linings, which are likely to be damaged during removal, are not.
- Partition – non demountable: A partition system in which major components, such as panels or linings, are likely to be damaged during removal and may require cutting, trimming or structural repair before reuse.
- Cool room panel system: A partition system fabricated to suit specific thermal conditions in which the insulated panels are designed to be removed and reused but panels or trims are likely to be damaged during removal.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following stages:
- Installation of framing / fixings before they are enclosed.

1.3 SUBMISSIONS

Samples
Submit samples as follows:
- A sample, at least 300 x 300mm, of each panel type.
- Floor and ceiling fixings and adjustments.
- Samples at least 100 mm long of each structural section, including posts, sills, transoms, door frames, ceiling channels and metal channel headrails, and each moulding, cover strip and bead.
- Skirting, skirting duct, skirting duct stop ends, returns and removable covers.

1.4 TOLERANCES

General
Deviation (from true grid lines and planes): up to 3 mm maximum in a 1500mm length.
Misalignment (of adjoining surfaces at grid junctions): 3 mm maximum.
Flatness, twist and bow: Maximum 3 mm deviation from a 1500mm straightedge placed in any position.

2 PRODUCTS

2.1 PARTITIONS

General
Provide proprietary non-load-bearing partition wall framing and lining comprising cold formed steel or extruded aluminium members, or both, in conformance with the drawings.

Building movements
Provide clearances or movement joints so that partitions are not damaged by structural building movements such as long term slab deflection. Where fire resistance or acoustic properties are
specified provide a resilient foam or mastic seal having properties equal to those required for the partition.

**Control joints**
General: Provide for control joints in sheet finishes where required by the structural frame.

---

### 3 EXECUTION

#### 3.1 PREPARATION

**General**
Prepare the base to receive the partitions. Ensure that all surfaces are flat without lumps or hollows that could affect the performance of the partition system.

**Set out**
Set out the partitions so that the partition grid, as expressed in panel joints and centre lines of frame members, coincides with the ceiling grid and the building grid, if applicable.

#### 3.2 ERECTION

**Partition erection**
Install the partitions so they:
- Are plumb, level, on their correct alignments, and firmly fixed.
- Have adequate top support by fixing the top plate to the ceiling structure or slab soffit, or are stabilised by lapping and fastening intersecting or butting plates together.
- Have bottom plates fixed at 600 mm maximum centres generally, and 100 mm maximum from ends.

Install coolroom panel systems to manufacturers recommendations and standard details where feasible. Ensure that all seal strips, cover strips, accessories, fixings needed to satisfactorily carry out the installation are provided and installed to the approval of the Engineer.

**Fixing**
Conceal fixings. For demountable items provide fixings capable of being repeatedly removed and replaced without damage to finishes.

Fixing to masonry: Provide masonry anchors of expansion or chemical grout type. Do not provide explosive-driven fastenings.

Fixing to suspended ceilings: Provide adequate top support to the partition without damage to the ceiling components.

**Protection**
Protect existing work from damage during the installation and make good any damage. Provide temporary coverings if necessary.

**Sound properties**
Preserve the sound reduction properties of partitions by sealing flanking sound transmission paths during installation, including junctions between partitions and other building surfaces, air gaps around doorsets, recesses, such as pelmets and blind boxes and cut-outs for services. Avoid cut-outs next to or back-to-back with each other.

Sealing methods: Use appropriate sealing methods, such as durable resilient gaskets or closed cell foam strips. Provide solid resilient materials in preference to foamed materials whenever possible.

**Support**
Provide additional support in the form of framing for fixing hardware, fixtures and fittings.

#### 3.3 SERVICES

**Services access**
Conceal associated building services, either within cavities in the partition structure, or within ducted skirtings supplied as part of the partition system, or both. Provide removable or demountable components of the partition system, for access to services concealed within partition cavities.
5.3 ROOM DIViders

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Overhead tracks installed before dividers/door panels are hung and ceiling installed.

1.2 SUBMISSIONS

Samples
Submit 2 samples of each of the following where applicable:
- Sections proposed to be used for frames, louvres and slats.
- Colour range samples of facings and prefinished production material.
- Manufacturer’s standard door furniture items.

1.3 TOLERANCES

Tolerances
Deviation (from true grid lines and planes): up to 3 mm maximum in a 1500mm length.
Misalignment (of adjoining surfaces at grid junctions): 3 mm maximum.
Flatness, twist and bow: Maximum 3 mm deviation from a 1500mm straightedge placed in any position.

2 EXECUTION

2.1 COMPLETION

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

Cleaning
Temporary coating: 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.

3 SELECTIONS

Refer to the drawings for details of room dividers for the works.
5.4 SUSPENDED CEILINGS

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the framing preparation and setout of suspended ceilings before installation of panels.

1.2 SUBMISSIONS

Samples
Submit samples as follows:
- Ceiling material: Sheet, panel, tile, with insulation
- Methods: Methods of jointing, fixing, height adjustment.
- Suspension: Sections proposed for suspension system, including wall angles and trim.

2 PRODUCTS

2.1 LININGS

Fibrous plaster tiles
Best quality imported fibrous plaster tiles with hard cast plaster face for decorative ceiling sections.

Plasterboard panels
Best quality imported glass fibre reinforced gypsum plasterboard panels or tiles.

3 EXECUTION

3.1 INSTALLATION

Ceiling grid
Set out the ceiling grid so that panel joints and centrelines of visible suspension members coincide with grid lines shown on the drawings. If not otherwise shown, set out so that opposite margins are equal.

Pattern and texture: Set out patterned or heavily textured materials to give consistency in direction of pattern or texture.

Special sized panels: Provide special sized purpose-made panels to fill non-standard margins, openings and penetrations.

Cut tile edges
General: Conceal, or finish to match prefinished edges.

Lighting
Fit lights within the ceiling grid system to ensure that distortion, overloading or excessive vertical deflection is prevented. Support lights on the ceiling primary grid members.

Proprietary systems
Provide suspended ceilings as complete proprietary systems, each fabricated by one manufacturer and installed by a specialist installer of demonstrated capacity.

Protection
Protect existing work from damage during the installation.

Stability
Install the ceilings level; and fix so that under normal conditions there is no looseness or rattling of ceiling components.
3.2 SUPPORTS

Bracing
General: Provide bracing to prevent lateral movement and to resist any imposed horizontal seismic force.

External suspended ceilings
Support external suspended ceilings on rigid members capable of carrying the imposed loads. Install members to minimise any eccentricity, and ensure that the upward and downward wind loads are carried through to the supporting structure.

Movement joints
Install the ceiling with control joints to correspond in location and direction to those in the structural frame.

Finishes
Repair damaged finishes by replacement or refinishing of the item. All repairs are to be completed so no sign of the damage is visible in the completed work.

Support members
Grid members: If required, notch grid members at the junction with the perimeter trim to ensure the panels lie flat on the perimeter trim.
Services: Do not suspend from services (e.g. pipework or ductwork) unless the service has been designed to accept the ceiling load. In locations where services obstruct the ceiling supports, provide bridging and suspension on each side of the services.
Spacing: Space the support members as required by the loads on the system and the type of ceiling, and allow for the installation of services and accessories, including ductwork, light fittings and diffusers. Provide additional support or suspension members for the fixing of such items.

Suspension system
Height adjustment: Provide height adjustment by means of a length adjustment device at each suspension point, permitting length variation of at least 50 mm.

3.3 PANELS

General
Fitting: Fit panels accurately and neatly, free from air leakage and staining.
Panel lock clips: If panels are exposed to wind loads or if required for security, insert locking clips at the junction of rails and panels.

Accessories and trim
Provide accessories and trim necessary to complete the installation.
Plasterboard trim: Provide purpose-made corner beads, casing beads and stop beads.
Metal Trim: Provide trims at junctions with other building elements and surfaces, such as walls, beams and penetrations, consistent with the style, materials and finishes of the ceiling system generally.

Service penetrations
Provide openings for, and fit the ceiling system up to, all services elements such as light fittings, ventilation outlets, detectors, sprinklers and loudspeakers.

3.4 ACCESS PANELS

Finish
Match the ceiling panels in appearance and performance and mark the panel for easy identification.

3.5 COMPLETION

Spares
Supply spare matching tiles and accessories of each type for future replacement purposes. Store the spare materials on site where directed.
5.5 JOINERY

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.

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.

Sample table

<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.

#### 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.
- 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 Drawings for locations, type and finishes of joinery items.
5.6 METALWORK

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.

<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 discolor 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 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.
- 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.

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.

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.

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.
5.7 STAINLESS STEEL BENCHING

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the units when fabrication is complete, before delivery.

1.2 SUBMISSIONS

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

<table>
<thead>
<tr>
<th>Sample table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
</tr>
<tr>
<td>Typical joints of welded or fabricated items</td>
</tr>
<tr>
<td>The finish to all stainless steel items</td>
</tr>
</tbody>
</table>

Stainless steel: For each batch of stainless steel supplied to the works, submit the certificate of compliance specified for the applicable standard.

Site welding
General: If site welding is proposed, submit details indicating location and process.

2 PRODUCTS

2.1 MATERIALS

Stainless steel
Plate, sheet, strip, bar and pipe: To ASTM standards.
Type: 304.

Stainless steel sheet
Surface finish: Fine brushed finish not including to underside of shelves, and door backs and drawer backs.
Thickness: 1.2 mm minimum.

Particleboard
Use moisture resistant particleboard minimum thickness 12mm to splashback and 25mm to benchtop as substrate for support of flat sheet.

Plywood
Use external grade structural plywood minimum thickness 12mm to splashback and 25mm to benchtop as substrate for support of flat sheet.

2.2 COMPONENTS

Fasteners
Material: Stainless steel.
Dimensional system: Metric.
Bolt and screw heads: Polished, pan type or countersunk.

Hardware
Material: Stainless steel.
Handles: Stainless steel unless noted otherwise.
**Sealants**
Type: Neutral cure one-part silicone.

**Adhesive**
Type: Spray contact adhesive.

### 3 EXECUTION

#### 3.1 FABRICATION GENERALLY

**Stainless steel welding**
Process: Gas tungsten arc welding.
Weld type: Butt.
Surface finish: Grade I, 120 grit.
Welding materials: Compatible with metal being welded.
Weld quality: Free from imperfections such as cracks and pits. Grind and polish to give required surface finish. Continuous exposed welds.
Joints: Strength at least that of parent metal. Free from crevices and folds.
Joint position: At corners and edges as far as possible. Minimise joints in flat panels.

**Protection**
Provide temporary self-adhesive plastic film to stainless steel surfaces.

**Hardware fixing**
Drill and tap, or weld fix.

**Linishing grain direction**
Benches and shelves: Lengthwise.
Bows: Horizontal to sides, parallel to bench grain to bottom. Mitre at bottom corners.
Abutting surfaces: Parallel where possible.

#### 3.2 BENCH TOPS FABRICATION

**Bench tops**
Material: Stainless steel sheet.
Thickness: 2 mm.
Refer to drawings for details of bench construction and nominal overall sizes. Confirm all dimensions on site before fabricating bench units.
Exposed corners: Radius exposed corners at least 5 mm, including back vertical corners of upstands.
Internal back vertical corners: Fuse only from behind.
Wet bench perimeter: Except at wall flashing, provide a raised bead, with a fascia.
Dry bench perimeter: Except at wall flashing, provide a fascia.

**Fascia**
Fascia height: 30mm unless noted otherwise.
Fascia return: Full depth of bench top unless noted otherwise.

**Drainer**
Drainer falls to sinks: 1:50, 450 mm long.
Drainer surface: Plain.

**Wall splashback**
Type: Integral.
Height above bench: 300mm unless noted otherwise.
Ends: Return for full width of bench top.
Fixing to support frame
Type: Screw fix benchtop to support frame through welded lugs on front and back frames at 600mm centres into plywood or particleboard substrate. Provide star washers under screwheads.
If no substrate is used, weld benchtop to frame on welded lugs on front and back frames at maximum 300mm centres.

3.3 BOWL FABRICATION

Bowls
Type: Deep drawn stainless steel.
Thickness:
- Capacity < 75 L: 1.6 mm.
- Capacity ≥ 75 L: 2 mm.
Internal radii: 25 mm minimum.
Minimum depth: 250 mm.
Wastes:
- Size (minimum): 50mm diameter.
- Position: Centred in single bowls, adjacent in double bowls.
- Plug: Heavy-duty commercial.
Fall to waste (minimum):
- Capacity < 75 L: 10 mm.
- Capacity ≥ 75 L: 25 mm.

3.4 FRAME FABRICATION

Bench top support frame
Support: Provide sufficient support so that no load is placed on the waste pipe or water connections.
- Design deflection (maximum): 3 mm.
Members: 31.8 x 31.8 x 1.6 mm stainless steel pipe. Seal ends.
Extent: Perimeter and at sides of bowls, with additional members spaced as follows:
- 1.6 mm sheet: 350 mm maximum centres.
- 2 mm sheet: 500 mm maximum centres.
Maximum unsupported area: 0.3 m².
If 25mm plywood or particleboard substrate is used, the benchtop can be supported on front and back rails only, with additional members at 1200mm maximum centres.
Connections: Welded.

Bench legs
Members: 31.8 x 31.8 x 1.6 mm stainless steel pipe. Seal ends.
Fixing to bench top support frame: Weld all around at junctions.
Spacing: 1200 mm maximum.
Fixing to walls: Predrilled 100 x 50 x 2 mm stainless steel plate welded to legs at 600 mm high.
Feet: Nylon or chrome-plated aluminium, adjustable vertically ± 25 mm. Threaded section must not protrude from leg.

3.5 SHELVING FABRICATION

Under bench shelving
Material: Stainless steel.
Thickness: 1.6 mm.
Shelf support: 30 x 30 x 5 mm stainless steel angles.
- Extent: Perimeter, with additional angles spaced to give a maximum unsupported area of 0.3 m².
Connections: Welded.
Fixing of support to legs: Welded.
If 25mm plywood or particleboard substrate is used, the shelf can be supported on front and back rails only, with additional members at 1200mm maximum centres.

Fixing of shelf to support: as for benchtop support.

**Over bench shelving**

Material: Stainless steel.
Thickness: 1.6 mm.

Shelf support: 25.4 x 25.4 x 1.6 mm stainless steel pipe brackets minimum 300mm high above the shelf level. Seal ends.

- Spacing: 900 mm maximum with 25mm substrate or shelf fabricated with 30 x 30 x 5 mm stainless steel angles, 600mm with 12mm substrate.

- Fixing to wall: Two 50 x 50 x 5 mm stainless steel plates, fixed with at least two M8 bolts. Weld to top and bottom of the support brackets.

Fixing of shelf to support: Screw fix minimum of 3 times through tube into side of shelf or shelf angles. Seal between shelf and support.

### 3.6 DRAWERS FABRICATION

**Drawers**

Material: Stainless steel.
Thickness: 1.2 mm.

Construction: Welded.

Frames: Removable, and interchangeable with other drawer frames. Provide extension-type drawer slide mechanism and front panel. Provide rubber stops at rear.

Front panel: 20 mm thick double pan construction.

Housing: Back and 2 sides, of a neat external appearance.

Runners: Incline to rear so drawers roll closed. Provide stop so drawer cannot be pulled out accidentally.

Locks: Chrome-plated brass.

### 3.7 INSTALLATION GENERALLY

**Welding**

Preference should be given to any other fixing method other than site welding. Obtain approval from the Engineer for any proposed site welding.

**Sealing**

Gaps < 5 mm wide: Apply sealant at the following locations:
- Butt joints between benches.
- Between benches, including flashings, and walls.
- Spaces and gaps under benches.

Gaps ≥ 5 mm wide: Close with stainless steel infill panels.

**Floor fixing**

8 mm diameter stainless steel dowels, sealed to floor with silicone sealant.

### 3.8 COMPLETION

**Protection**

General: Temporary self-adhesive plastic film: Remove from stainless steel surfaces.
5.9 WINDOW COVERINGS

1 GENERAL

1.1 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the building locations and surfaces prepared to receive window coverings before installation.

1.2 SUBMISSIONS

Samples
Submit 2 samples of each of the following where applicable, for approval by the Engineer:
- Sections proposed to be used for frames, louvres and slats.
- Finishes to prepared surfaces with trims.
- Colour range samples of fabrics, facings and production material.
- Manufacturer’s standard control system furniture items.

2 PRODUCTS

2.1 MATERIALS

Fire hazard
Do not provide materials which, when subject to fire conditions, will emit excessive smoke or dangerous fumes.

3 PRODUCTS

3.1 INTERNAL

Curtains and fabric shades
Install curtains or shades to locations identified on drawings or in BOQ. Check all dimensions on site before fabricating track and making curtains.

Aluminium Venetian blinds
Install aluminium blinds to locations identified on drawings or in BOQ. Check all dimensions on site before fabricating track and making blinds.
Slat material: High tensile aluminium alloy.
Thickness: 0.175 mm.
Cord: 1.5 mm thick polyester with braided jacket and safety tassel, and ladders for location and control.
Top and bottom rails: 0.5 mm aluminium zinc coated steel powdercoat finish.

Plastic Venetian blinds
Install plastic blinds to locations identified on drawings or in BOQ. Check all dimensions on site before fabricating track and making blinds.
Slat material: Extruded polystyrene.
Thickness: 3 mm nominal.
Slat width: 50 mm nominal.
Cord: Internal 2.3 mm thick polyester.
Tape: To allow a 42 mm pitch between ladders and a 8 mm slat overlap.
Top and bottom rails: 0.5 mm aluminium zinc coated steel powdercoat finish.
Timber Venetian blinds
Install timber blinds to locations identified on drawings or in BOQ. Check all dimensions on site before fabricating track and making blinds.
Slat material: Approved timber
Thickness: 5 mm nominal.
Slat width: 50 mm nominal.
Cord: Internal 2.3 mm thick polyester.
Tape: To allow a 42 mm pitch between ladders and a 8 mm slat overlap.
Top and bottom rails: 0.5 mm aluminium zinc coated steel powdercoat finish.

Vertical louvre blinds
Install vertical blinds to locations identified on drawings or in BOQ. Check all dimensions on site before fabricating track and making blinds.
Type: Louvres supported by a carrier system which traverses on wheels and operates with a friction spring loaded clutch mechanism.
Louvre blades: Heavy duty fabric or vinyl coated fabric blades in single, straight lengths finishing 10 mm above floor or sill level, without twists, warp, bows, edge ripples or fraying. Fix a weight into a pocket formed in the bottom of each blade.
Spacings: Space the blades evenly with plastic spacers which lock into the carrier rail to provide a continuous linkage, and fix with sealed plastic slat holders carried by plastic rotation pivots. Connect the bottoms of the blades by a plastic link chain with reversers.
Tracks: Fabricated to suit size of blades for width of window or within a pelmet extending past the face of the window.
Operation: Dual continuous loop chains controlling the functions of tilting and drawing.

4 EXECUTION

4.1 INSTALLATION
General
Fixing: Secure the tracks with ceiling clamps or wall mounted brackets so that there are no fixings through the track.

4.2 COMPLETION
Maintenance manual
Submit the manufacturers’ data as follows:
- Recommendations for service use, care and maintenance.
- List of manufacturers and suppliers of replacement parts.
6.1 PLASTERING

5     GENERAL

5.1     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.

5.2     INSPECTION

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

6     PRODUCTS

6.1     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>CRS</td>
<td>Dense and smooth concrete and masonry</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Thrown finishing treatments</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Tiled finishes</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Gypsum finishes</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Cement finishes</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>Cement finish coats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRF</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>LF</td>
<td>Cement render base coats</td>
<td>-</td>
</tr>
<tr>
<td>Gypsum finish coats</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.

7 EXECUTION

7.1 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.

### 7.2 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.

### 7.3 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>Features¹: 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: Flatness² in 2000 mm</td>
<td>4</td>
</tr>
</tbody>
</table>

¹ Features: Conspicuous horizontal or vertical lines including external corners, parapets, reveals, heads, sills, movement control joints and mouldings.

² Flatness: Measured under a straightedge laid in any direction on a plane surface.
7.4 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.
6.2 CEMENTITIOUS TOPPINGS

1  GENERAL

1.1  INTERPRETATIONS

Abbreviations
For the purposes of this worksection the abbreviations given below apply.
- BCS: Bonded – cement and sand.
- BFC: Bonded – fine concrete.
- FFC: Floating – fine concrete.
- MGR: Monolithic – granolithic.
- SFC: Separated – fine concrete.

1.2  TOLERANCES

General
Thickness:
- Thickness < 15 mm: ± 2 mm.
- Thickness ≥ 15 < 30 mm: ± 5 mm.
- Thickness ≥ 30 mm: ± 10 mm.
Flatness: Measured under a 3000 mm straightedge laid in any direction on a plane surface:
- Grade A: < 3 mm.
- Grade B: ≥ 3 < 5 mm.
- Grade C: ≥ 5 < 10 mm.

2  PRODUCTS

2.1  PRODUCTS

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.

Aggregates
Coarse aggregate: To be nominal single size.
Fine aggregate: 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 toppings to concrete 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 toppings.
Integral pigment proportion: 5% by mass of cement.

Coloured chips
To be marble chips of selected colour or proprietary products manufactured for distribution in cement toppings.
Concrete
On site batch mixed concrete shall have characteristics and proportions of concrete ingredients which conform to those specified in M-150 (1:2:4).

Curing products
To be proprietary products manufactured for use with cement-based toppings and with the floor finish to be laid on the toppings.

Mixes
Provide concrete as follows or select mix proportions to the Mixes table.
- Air entrainment: ≤ 3%.
- Nominal coarse aggregate size: ≤ 0.3 x topping thickness.
- Slump: 80 mm.
Water quantity: Use the minimum necessary to achieve full compaction and prevent excessive water being brought to the surface during compaction.

Mixes table

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Thickness (mm)</th>
<th>Upper and lower limits of proportion by mass (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cement</td>
</tr>
<tr>
<td>Bonded – cement and sand</td>
<td>BCS</td>
<td>35</td>
</tr>
<tr>
<td>Bonded – fine concrete</td>
<td>BFC</td>
<td>40</td>
</tr>
<tr>
<td>Floating – fine concrete</td>
<td>FFC</td>
<td>100</td>
</tr>
<tr>
<td>Monolithic – granolithic</td>
<td>MGR</td>
<td>Floors and treads: 25</td>
</tr>
<tr>
<td>Riser and skirtings: 13</td>
<td></td>
<td>Floors and treads: 25</td>
</tr>
<tr>
<td>Separated – fine concrete</td>
<td>SFC</td>
<td>70</td>
</tr>
</tbody>
</table>

Movement control joint products
Provide products manufactured for use with cement based toppings and accommodate the anticipated movement of the backgrounds and/or the toppings.

Sealing products
Provide proprietary products manufactured for the sealing of movement joints in cement-based toppings.

Slip-resistance products
Provide proprietary products manufactured to improve the wet-slip resistance of toppings.
- Silicon carbide granules:
  - Granule size: ≥ 300 < 600 µm.
  - Colour: Black.

Surface treatment products
Provide proprietary products manufactured for use with cement-based toppings to change the characteristics of the surface of the finished topping.

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

3 EXECUTION

3.1 PREPARATION

Backgrounds
Ensure backgrounds have:
- Any deposit which may impair adhesion of monolithic or bonded toppings cleaned off.
- Excessive projections hacked off and voids and hollows filled with a mix not stronger than the background nor weaker than the topping.
- Hardened concrete roughened by scratching or hacking to remove 2 mm of the surface and expose the aggregate.

Bonded toppings
Before laying topping wash the subfloor with water and use a bonding product or treat as follows:
- Keep wet for ≥ 2 hours.
- Remove surplus water and brush on neat cement or a clean slurry of cement and water.
- Place the topping while the slurry is wet.

3.2 APPLICATION

Laying
Spread the mix and compact and level the surface to finished levels.
Monolithic toppings: Lay while concrete subfloor is plastic and surface water is no longer visible.
Toppings over 50 mm thick:
- Lay in two layers of equal thickness.
- Place a layer of reinforcement between the layers of toppings. Lap reinforcement 100 mm and tie. Do not create four way laps.

Floating and trowelling
Machine float finish:
- After levelling, consolidate the surface using a machine float.
- Cut and fill and refloat immediately to a uniform, smooth, granular texture.
- Hand float in locations inaccessible to the machine float.
  Flatness: Grade B.
Steel trowel finish: After machine floating finish as follows:
- When the surface has hardened sufficiently, use steel hand trowels to produce the final consolidated finish free of trowel marks and uniform in texture and appearance.
  Flatness: Grade A.
Wood float finish: After machine floating finish as follows:
- Use wood or plastic hand floats to produce the final consolidated finish free of float marks and uniform in texture and appearance.
  Flatness: Grade A.

Floor finish dividers
Finish cementitious toppings at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitable fixed to the background, with top edge flush to the finished floor. If changes of floor finish occur at doorways make the junction directly below the closed door.
**Monolithic toppings**
Coved skirtings: Form coves in the topping material, and finish the top to a neatly struck line. Mitre internal and external angles. 10 mm radius to top of skirting, 25 mm radius to junction between floor and skirting.

**Movement control joints**
Provide movement control joints to divide toppings into bays as follows
- Form in situ using square edge steel forms and trowelling a 3 mm radius to edges.
- Form a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
- Install a movement control joint product.
Bay sizes:
- Area: ≤ 15 m².
- Length to width ratio: ≤ 1:1.5.
Joints in background: Provide movement control joints in toppings to coincide with joints in the background.

**Slip-resistance treatment**
Stair treads: Form two grooves and fill with a silicon carbide two-part resin.
- Dimensions: 10 mm deep, 15 mm wide, length ≥ width of tread less 100 mm.
- Position:
  - First groove: Centre 35 mm from tread nose.
  - Second groove: Centre 60 mm from step nose.
Plane surfaces: Apply silicon carbide granules after floating and before the topping surface has set, and trowel into the surface so that the granules remain exposed.
- Application rate: 1 kg/m² evenly distributed.

**Surface colouring**
Apply the colouring product or coloured marble chips after floating and before the topping surface has set and trowel into the surface so that it is even in colour distribution.

**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 COMPLETION

**Curing**
General: Prevent premature or uneven drying out and protect from the sun and wind.
Curing: Use a curing product or, as soon as it has set sufficiently, keep the toppings moist by covering with polyethylene film for seven days.
6.3 TILING

1  GENERAL

1.1  INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Floor preparation and set out of floor tiles before fixing.
- Wall preparation and set out of wall tiles before fixing.
- Control joints before sealing and grouting.

1.2  SUBMISSIONS

Samples
Submit labelled samples of tiles, including fittings, accessories, grout and sealants, illustrating the range of variation in colour and finish.

1.3  INTERPRETATIONS

Definitions
For the purposes of this worksection the definitions given below apply.
- Substrates: The surfaces on which tiles are bedded.
- Bedding: Mixtures of materials which are applied to substrates in a plastic state and dry and cure to adhere tiles to substrates.
  - Adhesive bedding: Tiling adhered by adhesives.
  - Mortar bedding: Tiling adhered in a cementitious mortar bed.
- Pavers: Slabs made from clays, stone, precast concrete and/or other inorganic raw materials generally over 20 mm thick used as coverings for floors and supported over continuous substrates.
- Tiles: Thin slabs made from clays and/or other inorganic raw materials used generally as coverings for floors and walls and adhered to continuous supporting substrates.
  - Natural stone: Tiles cut from natural stone.
  - Industrial cast: Tile products of reconstituted stone. Also known as manufactured stone.
  - Cementitious: Manufactured cement based pre-finished tiles.
  - Terrazzo – cementitious: Manufactured cementitious terrazzo tiles formed in a suitable machine to give sufficient compaction and density to the finished surface, and moisture cured before grinding and honed at the place of manufacture. Thickness usually 35 mm.
- Wet areas: Areas within buildings with water supply and drainage systems.

1.4  TOLERANCES

Completed tiling
Conform to the Tolerances table.

Tolerances table

<table>
<thead>
<tr>
<th>Property</th>
<th>Tolerance criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment: Deviation of the finished tiles from a 3 m straight edge laid against any joints</td>
<td>&lt; 4 mm</td>
</tr>
<tr>
<td>Flatness: Deviation of any plane surface under a 3 m straight edge laid in any direction on an area of uniform grade</td>
<td>&lt; 4 mm</td>
</tr>
</tbody>
</table>
2 PRODUCTS

2.1 TILES AND ACCESSORIES

Tiles
Coves, nosings and skirttings: To be matching stop-end and internal and external angle tiles moulded for that purpose.
Exposed edges: To be purpose-made border tiles with the exposed edge glazed to match the tile face. If such tiles are not available, round edge with grout.

2.2 ADHESIVES

Type
General: Provide adhesives compatible with the materials and surfaces to be adhered.
Prohibited uses: Do not provide the following combinations:
- Cement-based adhesives on wood, metal, painted or glazed surfaces, gypsum-based plaster.
- Organic solvent-based adhesives on painted surfaces.
- Organic PVC-based adhesives and organic natural rubber latex adhesives in damp or wet conditions.
- PVA (polyvinyl acetate) based adhesives in wet areas or externally.

2.3 MORTAR

Materials
Cement: Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.
- White cement: Iron salts content ≤ 1%.
- Off-white cement: Iron salts content ≤ 2.5%.
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.
Sand: Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts.
Measurement of volume: Measure binders and sand by volume using buckets or boxes. Do not allow sand to bulk by absorption of water.

Bedding mortar
Proportioning: Select proportions from the range 1:3 – 1:4 cement:sand to obtain satisfactory adhesion. Provide minimum water.
Terra cotta tiles: Use proprietary polymer modified mortar.

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

2.4 GROUT

Type
Cement based proprietary grout: Mix with water. Fine sand may be added as a filler in wider joints.
Terra cotta tiles: Use proprietary polymer modified grout.
Portland cement based grout: Mix with fine sand. Provide minimum water consistent with workability.
- For joints < 3 mm: 1 cement:2 sand.
- For joints ≥ 3 mm: 1 cement:3 sand.

Pigments
Pigments for coloured grout: Provide colourfast fillers compatible with the grout material. For cement-based grouts, provide lime-proof natural or synthetic metallic oxides compatible with cement.
Provide tiling systems to walls, floors and other substrates as follows:
- Consistent in colour and finish.
- Firmly bonded to substrates for the expected life of the installation.
- Resistant to expected impacts in use.
- Set out with joints accurately aligned in both directions and wall tiling joints level and plumb.
- To direct all water flowing from supply points to drainage outlets without leakage to the substrate or adjacent areas.

3.1 SUBSTRATES

Drying and shrinkage
Before tiling, allow at least the following times to elapse (for initial drying out and shrinkage) for these substrates:
- Concrete slabs: 42 days.
- Concrete blockwork: 28 days.
- Toppings on slabs and rendering on blockwork: A further 21 days.

3.2 PREPARATION

Ambient temperature
If the ambient temperature is less than 5 or more than 35°C, do not lay tiles.

Substrates
Ensure substrates are as follows:
- Clean and free of any deposit or finish which may impair adhesion or location of tiles.
- If solid or continuous, excessive projections are hacked off and voids and hollows are filled with a cement:sand mix not stronger than the substrate nor weaker than the bedding.

Absorbent substrates: If suction is excessive, control it by dampening but avoid over-wetting and do not apply mortar bedding to substrates showing surface moisture.

Dense concrete: If not sufficiently rough to provide a mechanical key, roughen by scratching or hacking to remove 3 mm of the surface and expose the aggregate; then apply a bonding treatment.

3.3 TILING GENERALLY

Sequence
General: Fix wall tiles before floor tiles.

Cutting and laying
Cutting: Cut tiles neatly to fit around fixtures and fittings, and at margins where necessary. Drill holes without damaging tile faces. Rub edges smooth without chipping.

Laying: Return tiles into sills and openings. Butt up to returns, frames, fittings, and other finishes.

Variations
Distribute variations in hue, colour, or pattern uniformly, by mixing tiles or tile batches before laying.

Protection
Floor tiles: Keep traffic off floor tiles until the bedding has set and attained its working strength.
Cleaning: Keep the work clean as it proceeds and protect finished work from damage.

3.4 SETTING OUT

Tile joints
Set out tiles to give uniform joint widths within the following limits:
- Ceramic floor tiles: 4 to 6 mm.
- Quarry floor tiles: 6 to 12 mm.
- Terrazzo and stone pavers to floor: 2 to 3 mm.
- Large and/or irregular floor tiles: 6 to 12 mm.
- Mounted mosaics: To match mounting pattern.
- Ceramic wall tiles: 3 to 5 mm.
- Terrazzo and stone wall panels: 2 to 3 mm.

**Margins**
Provide whole or purpose-made tiles at margins where practicable, otherwise set out to give equal margins of cut tiles. If margins less than half tile width are unavoidable, locate the cut tiles where they are least conspicuous.

**Fixtures**
If possible position tiles so that holes for fixtures and other penetrations occur at the intersection of horizontal and vertical joints or on the centre lines of tiles. Continue tiling fully behind fixtures which are not built in to the tiling surface. Before tiling ensure that fixtures interrupting the tile surfaces are accurately positioned in their designed or optimum locations relative to the tile layout.

### 3.5 FALLS AND LEVELS

**Grading**
Grade floor tiling to even and correct falls to floor wastes and elsewhere as required. Make level junctions with walls. Where falls are not required lay level.
- Fall, general: 1:100 minimum.
- Fall, in shower areas: 1:60 minimum.

### 3.6 BEDDING

**Preparation of tiles**
Adhesive bedding: Fix tiles dry; do not soak.
Mortar bedding: Soak porous tiles in water for half an hour and then drain until the surface water has disappeared.
Terra cotta tiles: Use pre sealed tiles or apply a breathable sealer and lay dry. If a final sealed finish is selected, use a compatible laying sealer.

**Bedding**
Use bedding methods and materials which are appropriate to the tile, the substrate, the conditions of service, and which leave the tile firmly and solidly bedded in the bedding material and adhered to the substrate. Form falls integral with the substrate.

**Thin adhesive beds**
Provide only if the substrate deviation is less than 3 mm when tested with a 3 m straight edge. Cover the entire tile back with adhesive when the tile is bedded.
- Thickness: 1.5 – 3 mm.

**Thick adhesive beds**
Provide on substrates with deviations up to 6 mm when tested with a 3 m straight edge, and with tiles having deep keys.
- Nominal thickness: 6 mm.

**Adhesive bedding application**
Apply adhesive by notched trowel to walls and floors and direct to tiles if required, to provide evenly distributed coverage after laying.
Wall tile spacers: Do not use spacer types that inhibit the distribution of adhesive.
Curing: Allow the adhesive to cure for the period nominated by the manufacturer prior to grouting or allowing foot traffic.

**Mortar beds**
For floor tiles: Either lightly dust the screeded bed surface with dry cement and trowel level until the cement is damp, or spread a thin slurry of neat cement, or cement-based thin bed adhesive, on to the tile back. Do not provide mortar after initial set has occurred.
- Nominal thickness: 20 to 40 mm.
3.7 MOVEMENT JOINTS

General
- Location:
  - Over structural (isolation, contraction, expansion) joints.
  - Close to external corners in large tiled areas.
  - Around the perimeter of the floor.
  - At junctions between different substrates.
  - To divide large tiled areas into bays, maximum 5 m wide, maximum 16 m².
  - At abutments with the building structural frame and over supporting walls or beams where flexing of the substrate is anticipated.
- Depth of joint: Right through to the substrate.
- Sealant width: 6 – 10 mm.
- Depth of elastomeric sealant: One half the joint width, or 6 mm, whichever is the greater.

Movement joint materials
Divider strip: A proprietary expansion joint consisting of a neoprene filler sandwiched between plates with lugs or ribs for mechanical keying. Set flush with the finished surface.
Sealant: Two-pack self-levelling non-hardening mould resistant, one-part silicone or polyurethane sealant applied over a backing rod. Finish flush with the tile surface.
Backing rod: Compressible closed cell polyethylene foam with a bond-breaking surface.

3.8 GROUTED AND CAULKED JOINTS

Grouted joints
Commence grouting as soon as practicable after bedding has set. Clean out joints as necessary before grouting.
Face grouting: Fill the joints solid and tool flush. Clean off surplus grout. Wash down when the grout has set. When grout is dry, polish the surface with a clean cloth.
Edges of tiles: Grout exposed edge joints.

Mosaic tiles
Grouting mosaics: If paper faced mosaics are to be bedded in cement mortar, pre-grout the sheeted mosaics from the back before fixing. After fixing, rub grout into the surface of the joints to fill any voids left from pre-grouting. Clean off surplus grout. When grout has set, wash down. If necessary use a proprietary cement remover.

Sealant joints
Provide joints filled with sealant and finished flush with the tile surface as follows:
- Where tiling is cut around sanitary fixtures.
- Around fixtures interrupting the tile surface, for example pipes, brackets, bolts and nibs.
- At junctions with elements such as window and door frames and built-in cupboards.
Width: 5 mm.
Depth: Equal to the tile thickness.

3.9 JOINT ACCESSORIES

Floor finish dividers
Finish tiled floors at junctions with differing floor finishes with a corrosion resistant metal dividing strip suitably fixed to the substrate, with top edge flush with the finished floor. Where changes of floor finish occur at doorways make the junction directly below the closed door.

3.10 COMPLETION

Cementitious terrazzo tiled surfaces
In situ grind and polish the completed installation with equipment nominated by the tile supplier.
Spare tiles
Supply spare matching tiles and accessories of each type for future replacement purposes. Store the spare materials on site where directed by the Engineer.
Quantity: At least 1% of the quantity installed.

Cleaning
Clean tiled surfaces using an appropriate tile cleaning agent, and polish.
6.6 PAINTING

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.

1.3 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.

2 EXECUTION

2.1 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.

2.2 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.

3 SELECTIONS

3.1 PAINT SYSTEMS

Paint system description

Choose from the following paint systems and substrates and paint in accordance with manufacturers recommendations:

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 **Drawings or as approved by the Engineer.**
### 1.0 Amendments to the QAP Register

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Author</th>
<th>Description of Change</th>
<th>Approved By</th>
</tr>
</thead>
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2.0 Preparation and Distribution of QAP

The Quality Assurance Plan is to be prepared by the QC Manager in collaboration with the relevant experts in their field as required. The Project Engineer shall also be responsible for the distribution of the QAP to all manual holders. The revision of quality assurance forms does not necessitate the reissue of the QAP.

The QAP will be approved by the Project Manager.

The QAP is to be distributed on-site to the Task Order Manager, Project Engineer, and be made available to the Inspectors and Engineers on-site. A copy shall also be given to the Project Manager. The QC Manager shall ensure that all manual holders receive any and all updates.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Name</th>
<th>Date</th>
<th>Signature of Receipt</th>
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3.0 Purpose of QA System

The purpose of the Quality Assurance System is to ensure that all works being constructed by the Contractor are properly documented, tested and surveyed as required by the Contract conditions. It provides the mechanism whereby only works that comply with these requirements are certified for payment.

In addition, Quality Assurance Plan is to provide guidance and direction for project personnel to perform the necessary tasks to verify that the quality of the contractor’s work complies with the specification and drawings and that the works are documented clearly for traceability.

4.0 Components of the QA Process

4.1 Requests for Approval (RFA):

The contractor shall submit for approval of his material sources, drawings, Method statements prior to incorporating any of these things in the works. The necessary RFA are as shown in the Inspection and Test plans for the various work components.

Inspection and Testing plans are to be developed by the Engineer to cover all items of work as required. The purposes of these plans are to clearly set out the type, frequency and nature of QC checks required along with the documentation required.

4.2 Approval To Proceed (ATP)

The approval to proceed is a submission made by the Contractor for an approval to proceed with the next item of work. Before the approval to proceed is granted the Engineer must be satisfied that all documentation and procedures are in place and conform to the relevant requirements and that all previously completed works are suitable to allow successive works to proceed. The Engineer then either grants the Contractor approval to begin his works or advises what issues are outstanding in order for the requested works to proceed.

Examples of what the Engineer must be satisfied with prior to granting an ATP includes but not limited to approved for construction drawings, ensuring safety certificates are attained, compliance of source materials has been approved and that preceding works are kept and maintained in its approved condition. Items requiring ATP’s are set out in ITP’s.

In order for the Quality Assurance System to function effectively, then it is important that the timely submittal and processing of the ATP’s occurs. To that effect it is the responsibility of all parties to ensure the time limits are adhered to.
ATP’s shall be submitted in a timely manner by the Contractor but will be submitted no later than the agreed time on the day prior to the stated inspection dates.

Works will be ready for inspection at the time stated by the Contractor or as agreed to by the Engineer prior to the inspection.

Works covered by the ATP will not proceed prior to the time stated or agreed to by Engineer.

All signed ATP’s will be returned to the Contractor not later than the agreed time on the day after the stated inspection date.

Where the Engineer’s representative does not attend the inspection at the stated or agreed time, then the ATP is ‘deemed’ to be approved by the Engineer shall be responsible for ensuring that all inspections and tests to demonstrate that the works comply with the requirements of the Contract Documents are carried out.

Similarly when a copy of the signed of the ATP is not returned to Contractor by the agreed time on the date following the inspection, the ATP is also ‘deemed’ to be approved. The Engineer shall be responsible for ensuring that all inspections and tests to demonstrate that the works comply with the requirements of the Contract Documents are carried out.

Where the Contractor does not afford the Engineer the opportunity of inspecting the works covered by submitting an ATP in accordance with these guidelines, then these works shall be at the option of the Engineer either removed at the Contractor’s expense or not accepted for payment.

4.3 Inspection Test Plans (ITP)

The Inspection Test Plans (ITP) detail the required testing and frequency required for a particular activity. It is important the ITP contains references to the acceptance criteria and frequency of sampling from the specifications. The ITP will be attached to the back of the inspection checklists for the reference of the inspectors on-site.

4.4 Inspection Checklists (IC)

Inspection Checklists generally form part of the Inspection Test Plans and are used by the inspectors checking the works. For each ITP there may be a number of checklists used as supporting documents with each required to be verified before the referenced hold point on the ITP can be released. The inspection checklists are also used for but not limited to goods delivered to site that require verification of quality, quantity, manufacture, size, source, etc.
The inspection checklist is used as a step by step pro forma to ensure all items have been verified as acceptable. Once the Inspection Checklist has been completed and the inspector is satisfied that all items meet the relevant standards, drawings or specifications then that checklist can be signed off as complete. These Checklists should be attached to the relevant ATP by the field inspector prior to submission of the ATP.

4.4.1 Document flow

4.5 Summary Chart

A summary chart is to be displayed in Engineer’s office to be maintained by the Project Engineer. It is to contain the major activities of the Contract with status of the ATP’s and Requisition Submittals displayed for each major activity.

4.6 Non Conformance Reports

The purpose of the Non-Conformance Report (NCR) is to effectively document works which for any reason whatsoever do not comply with the requirements of the Contract Documents. Secondly, NCR's also ensure that these works are isolated until effective rectification works are carried out, inspected and where necessary tested to ensure that they demonstrate compliance. The third major function of the NCR reports is to ensure that any deflective works are not paid for until rectification works are carried out and the works conform to the requirements of the contract documents.

The status of the NCR will be shown in a register and this register shall be kept up to date with monitoring to ensure that NCR's are resolved promptly and the rectification works carried out forthwith. These forms will be used as shown in the following flowchart.
If at any stage during the quality assurance system the Contractor fails to perform works which meet the specifications declared in the Contract, the Engineer will reject the works. A Non-Conformance Report (NCR) will be issued to document the rejection (Refer to Appendix F) of works. The Contractor will re-work the rejected works until re-testing can prove conformity to the specifications of the Contract

4.7 Site Instruction
The purpose of this document (SI) is to communicate contractor to

5 Document Control

5.2 Presentation and Control of Documents
Documents are to be presented as per the Conditions of Contract. Certain pertinent details are required to be displayed on the cover page including date submitted, contract number, contractor’s name and description of the document. Where applicable revision numbers are required to be shown on the document or submission.

Testing records are to include a sequential numbering system which can be used to identify test results for each material (to be explained in 8.2 coding of Documents).

6.0 Control of Non-Conforming Product

Non-conforming work will not be allowed to remain incorporated into the works. Neither will non-conforming works be certified for payment. Effective rectification works shall be carried out prior to this work being accepted and payment made. Rectification works shall depend on the nature and severity of the non-conformance.

All instances of non-conforming works shall be documented by the use of the NCR. It is the responsibility of the Project Engineer and Project Manager to ensure that non-conforming product is isolated and not incorporated into the works.

6 Appendices

6.2 Appendix A - Requisition Forms
6.3 Appendix B – Approval to Proceed
6.4 Appendix C – Inspection Test Plans & Inspection Checklists
6.5 Appendix D – Site Instruction Form
6.6 Appendix E – Non-Conformance Report

Appendix A : Request For Approval (RFA)

=Engineer: Contractor:
Request for Approvals for the following works:

- Materials
- Excavation/Foundations
- Roofings
- Finishing’s
- Painting
- Metal works
- walls and columns
- Carpentry and Joinery
- Plastering and Pointing

Location:
This will be ready on; Date: __________________ (day/month/year)

Contractor’s Comments/Description:

Submitted by: __________________ Date: __________________ (day/month/year)
(Contractor)

Received by: __________________ Date: __________________ (day/month/year)
(UNOPS)

Contractor Engineer’s Comments/Recommendations:

Engineer’s Comments:

- Approved
- Not Approved, Re-submit

Checked by: __________________ Date: __________________ (day/month/year)
(UNOPS)

Certified by: __________________ Date: __________________ (day/month/year)
(UNOPS)
Appendix –B: Request For Approval (RFA)

Engineer: Contractor:
Contract Number: Reference: RFA - 
Project Name: Date Submitted: 

Request for Approvals for the following works:

- Excavation
- Concrete
- Brick Work
- Stone Masonry
- Plastering, Pointing and Screeding
- Block work
- Metal Work
- Roofing
- Concrete
- Brick Work
- Carpentry and Joinery
- Painting
- Metal Work
- Roofing

Location
This will be ready on:

Date: 
Time: 

Contractor’s Comments/Description:

Submitted by: ______________ Date: ______________ (day/month/year)
(Contractor)

Received by: ______________ Date: ______________ (day/month/year)

<table>
<thead>
<tr>
<th>Underlying layer/preparation work</th>
<th>Contractor</th>
<th>Engineer</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Preliminary/Preparatory Works</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. General Conditions of Preparation work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Proof Rolling/Compaction if applicable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Approved Drawings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Traffic Control Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Materials and Field Testing Compliance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Source Approval/Matl Compliance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Field Testing (if applicable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Survey</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Alignment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Staking out Check</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(UNOPS)
I hereby certify that the work and all testing, approvals and documentation required has been carried out to the satisfaction of the Contract.

Certified by

☐ Approved to Proceed
☐ Approved to Proceed w/ Condition(s)
☐ Not Granted, Remedial Works Required

Task Order Manager/ Project Engineer

Date ____________________________

ENGINEER’S COMMENTS:

Contractor Engineer’s Comments/Recommendations:

________________________________________________________________________

________________________________________________________________________

Engineer’s Comments:

☐ Approved
☐ Not Approved, Re-submit

Checked by: ________________________ (UNOPS)  
Date: ____________________________ (day/month/year)

Certified by: ________________________ (UNOPS)  
Date: ____________________________ (day/month/year)
# Appendix C : Inspection Checklists

**Engineer:**

**Contractor:**

**Contract Number:**

**Reference:** ITS-EXC-

**Project Name:**

**Date commenced:**

---

### Excavation

```
+         TO         +
S/N     CHECKLIST ACTIVITY     REFERENCES     ENGINEER     COMMENTS
```

<table>
<thead>
<tr>
<th>S/N</th>
<th>Checklist activity</th>
<th>References</th>
<th>Engineer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Work Area de-mined</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>If excavation is for unsuitable, submit Request for Testing (RFT) (if applicable)</td>
<td>RFT-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>If excavation is for unsuitable, submit lab results of samples taken (if applicable)</td>
<td>Lab ref.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Approved drawings in hand for design grade/profile</td>
<td>Survey/Drawing ref.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Approval to Proceed (ATP) to commence excavation submitted and approved</td>
<td>ATP-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Traffic management has been put in place and is adequate (if applicable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Construction survey in place and adequate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Toes of slopes have not been undercut (if applicable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Excavation carried out to correct level and line</td>
<td>Survey/Drawing ref.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Excavated profile has been compacted (if applicable)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Request for Survey of excavated area has been submitted and approved (if applicable)</td>
<td>RFS-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Post-excavation survey has been undertaken and recorded</td>
<td>Survey/Drawing ref.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Testing references:

---

........................................../....../.........

UNOPS Inspector

ITP Attached
# Appendix C: Inspection Test Plans

<table>
<thead>
<tr>
<th>S/N</th>
<th>Operation or Stage of Work</th>
<th>Stage/Frequency</th>
<th>Records</th>
<th>Specification</th>
<th>Acceptance Criteria</th>
<th>Inspection/Test Procedure</th>
<th>Inspection by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contractor</td>
</tr>
<tr>
<td>1</td>
<td>Preliminary Approvals acquired</td>
<td>Before excavation</td>
<td>ATP, RFA &amp; ITS</td>
<td>Job requirement</td>
<td>Approved RFI &amp; RFA</td>
<td>Submit ATP &amp; RFA to Engineer for approval</td>
<td>H</td>
</tr>
<tr>
<td>3</td>
<td>Survey of Existing ground</td>
<td>Before excavation</td>
<td>RFS, Survey reports &amp; ITS</td>
<td>Job requirement</td>
<td>Approved RFS &amp; ITS</td>
<td>Submit RFS to Engineer for approval</td>
<td>H</td>
</tr>
<tr>
<td>4</td>
<td>Excavation to design (or affected area if unsuitable)</td>
<td>During excavation</td>
<td>ITS</td>
<td>Job requirement</td>
<td>Correctly excavated</td>
<td>Survey instruments and visual check of excavation to design</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Compaction of bottom of excavation</td>
<td>After excavation</td>
<td>RFT &amp; ITS</td>
<td>Section 3400, 5.1 (e)</td>
<td>100% MDD (if applicable)</td>
<td>AASHTO T99</td>
<td>W</td>
</tr>
<tr>
<td>6</td>
<td>Survey of Excavated ground</td>
<td>After excavation</td>
<td>RFS, Survey Report &amp; ITS</td>
<td>Job requirement</td>
<td>Approved RFS &amp; ITS</td>
<td>Submit RFS to Engineer for approval</td>
<td>H</td>
</tr>
<tr>
<td>7</td>
<td>Pre-Handover</td>
<td>After excavation</td>
<td>ATP, RFA, RFS, ITS, (&amp; RFT for unsuitable excavation)</td>
<td>Job requirement</td>
<td>All Requests and checklists completed and signed</td>
<td>Review</td>
<td>H</td>
</tr>
</tbody>
</table>

**H** - Hold Point  
**W** - Witness Point  
**X** - Self-Inspection
Appendix D: Site Instruction Form

Site Instruction Form:  

Instructed by: ___________  
(Date: __________________ (day/month/year)  
(UNOPS)  
Time: __________________

Received by: ___________  
(Date: __________________ (day/month/year)  
(Contractor)  
Time: __________________

Post-Compliance Description

Contractor’s representative: _______________  
(Date: _______________  
(day/month/year  

UNOP’s Representative: _______________  
(Date: _______________ (day/month/year)
# Appendix E: Non-Conformance Report

**Engineer:**

**Contractor:**

**Contract Number:**

**Project Name:**

**Reference:**

**TO: Project Manager**

**Attachment: Drawing / Sketch / Document:**

### DEFICIENCY / RECORD

<table>
<thead>
<tr>
<th>United Nations Office for Project Services</th>
<th>Proposed Remedial Work</th>
<th>Inspected by UNOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACCEPTABLE:</td>
<td>Remedial work acceptable:</td>
</tr>
<tr>
<td></td>
<td>NOT ACCEPTABLE:</td>
<td>Remedial work unacceptable:</td>
</tr>
</tbody>
</table>

**Acknowledgment of receipt by Contractor:**

Name: __________________________

Signature: __________________________

**Project Manager**

**Remedial Work Proposed by Contractor**

**Remedial Works will be carried out by the date below**

Name of Contractor’s Representative: __________________________

Date: __________________________

Signature: __________________________

**Date:** __________________________

**Name:** __________________________

**Signature:** __________________________
8 WATER SERVICES

1 GENERAL

1.1 AIMS

Responsibilities
Provide water services systems subject to the site and other constraints below:
- Cold water services: Connect the cold water supply system to the water source with a stop valve at the connection point. Provide the water source if required to suit the particular conditions as defined on the drawings. Provide the cold water installation to the draw-off points or connections to other services.
- Hot water services: Provide the hot water installation from the cold water connection points to the draw-off points or connections to other services.
- Hose reel system: Provide the hose reel system where defined on the drawings and in the BOQ.
- Sanitary plumbing and drainage: Provide the plumbing and drainage system where defined on the drawings and in the BOQ.
- Stormwater: Provide the stormwater system where defined on the drawings and in the BOQ.
- Subsoil drainage: Provide the subsoil drainage system where defined on the drawings and in the BOQ.

1.2 INSPECTION

Notice
Give sufficient notice so that inspection may be made of the following:
- Underground pipework prior to concealment.
- Above ground pipework prior to concealment.

1.3 SUBMISSIONS

Execution details
Before starting the respective portions of the installation, submit the following for approval from the Engineer:
- Embedded services: Proposed method for embedding services in concrete walls or floors or chasing into concrete or masonry walls.
- Fixing of services: Typical details of locations, types and methods of fixing of services to structure.
- Inaccessible services: If services will be enclosed and not accessible after completion, submit proposals for location of service runs and fittings.
- Proposals for location of exposed piping.

2 EXECUTION

2.1 INSTALLATION GENERALLY

Accessories
Provide the accessories and fittings necessary for the proper functioning of the systems, including taps, valves, outlets, pressure and temperature control devices, strainers, gauges and pumps.
Isolating valves: provide valves so that isolation of parts of the system in the event of leaks or maintenance causes a minimum of inconvenience to building occupants.

Arrangement
Services and equipment: Locate and arrange so that:
- Failure of plant and equipment (including leaks) does not create a hazard for the building occupants and causes a minimum or no damage to the building, its finishes and contents.
- maintenance operations can be carried out in a safe and efficient manner, with a minimum of inconvenience and disruption to building occupants and without damaging adjacent structures, fixtures or finishes.
Embedded pipes
Do not embed pipes that operate under pressure in concrete or surfacing material of a building without prior written approval. If embedding is approved:
- Install in continuous lengths without fittings wherever possible.
- Do not lay across joints between adjoining sections of concrete through which reinforcement does not extend.
- Pressure test and rectify leaks before the concrete is poured.

Penetrations and fixing
Limitations: Do not penetrate or fix to the following without prior approval:
- Structural building elements including external walls, fire walls, fire doors and access panels, other tested and rated assemblies or elements, floor slabs and beams.
- Membrane elements including damp-proof courses, waterproofing membranes and roof coverings.
Fire rated building elements: Seal penetrations with a system that maintains the fire rating of the element.
Membranes: If approval is given to penetrate membranes, provide a waterproof seal to the approval of the Engineer between the membrane and the penetrating component.

Piping
Install piping in straight lines, plumb and to uniform grades. Arrange and support the piping so that it remains free from vibration and water hammer, while permitting movement in both structure and services. Keep the number of joints to a minimum. Prevent direct contact between incompatible metals.
Concealment: If practicable, conceal piping and fittings requiring maintenance or servicing so that they are accessible within non-habitable enclosed spaces such as roof spaces, subfloor spaces and ducts. Provide at least 25 mm clearance between adjacent pipelines (measured from the piping insulation where applicable).
Cover plates: Where exposed piping emerges from wall, floor or ceiling finishes, provide cover plates of stainless steel or non-ferrous metal finished to match the piping.
Pipe support materials: To be the same as the piping or galvanized or non-ferrous metal finished to separate dissimilar metals.

Pits
Location: Install below-ground water meters, control valves and gas regulators in concrete access pits with removable pit covers.
Internal dimensions: To give 300 mm clear space all around the fittings in the pit.
Concrete: Grade M-200, 100 mm thick, with reinforcement fabric.
Pit covers: To be minimum of 5mm thick steel covers with finger holes for easy removal.
Installation: Grade floor to a point on one side and drain to the stormwater drainage system. Carry the pit walls up to 50 mm above finished ground level. Cast in the pit cover frame flush with the top. Trowel the top smooth.

Valve boxes
Location: Install underground isolating valves in concrete access pits with removable pit covers.
Identification: Mark the box covers with the name of the service.

2.2 INSTALLATION OF FIXTURES

General
Accessories: Use manufacturer’s brackets and accessories where these are available and suitable for the mounting substrate.
Protection: Deliver fixtures to site protected from damage under site conditions by coatings, coverings and packaging. Remove only sufficient protection to permit installation.

Installation
Connections: Connect to each fixture supply and waste services. Install plumb and level.
Cutting and fitting: If it is necessary to cut and/or fit substrate to install an item carry out this before the surface is finished or painted. Remove items when required for painting and protect until re-installed. Reinstall when painting and finishing is complete. Cap or plug the open ends of pipes.
Substrate and fixings: Before installation make sure that the substrate to which the fixtures are to be installed is adequate. In solid walls confirm adequacy of the material at fixing locations.

2.3 PAINTING, FINISHES AND MARKING

Exceptions
Do not paint chromium or nickel plating, anodised aluminium, glass reinforced plastic, stainless steel, non-metallic flexible materials and normally lubricated machined surfaces.

Finish exposed piping, including fittings and supports, as follows:
- In internal locations such as toilet and kitchen areas: Chrome plate copper piping with bright finish.
- Externally and steel piping and iron fittings internally: Paint.
- In concealed but accessible spaces (including cupboards and non-habitable enclosed spaces):
  Leave copper and plastic unpainted except for identification marking. Prime steel piping and iron fittings.

Valves: Finish valves to match connected piping.

Marking and labelling
Mark services and equipment to provide a ready means of identification.
- Locations exposed to weather: Provide durable materials.
- Pipes, conduits and ducts: Identify and label.

Consistency: Label and mark equipment using a consistent scheme across all services elements of the project.

2.4 HOT AND COLD WATER SERVICES

Fittings and accessories
Provide the fittings necessary for the proper functioning of the water supply system, including taps, valves, backflow prevention devices, temperature control devices, strainers.

Line strainers
Type: Low resistance, Y-form bronze bodied type, with screen of dezincification resistant brass, stainless steel or monel.

Screen perforations: 0.8 mm maximum.

Piping insulation
Application: Fit insulation tightly to piping surfaces without gaps. Minimise number of joints. Insulate fittings for the same thermal resistance as the piping insulation. Install the insulation on unions and other items requiring service so that it is readily removable. Provide supports formed to fit around the insulation so the insulation thickness is reduced by < 10%.

Material: Select from the following:
- Polyester in moulded tubular sections faced with factory bonded aluminium foil laminate or integral polyester scrim.
- Polyolefin foam: Cross linked closed cell polyolefin foam faced with factory bonded aluminium foil laminate.

Tapware
Provide the tapware in accordance with the drawings or as appropoalte.

Metal heads and handles: Provide brass fittings or suitably bush to prevent electrolysis and growth.

Plastic heads and handles: Provide break-resistant fittings of a compact nature, to prevent fracture and exposure of jagged or rough edges.

Tap positions: Locate hot tap to the left of or above, the cold tap.

Thermostatic mixing valves
Water temperature regulated by a single hand control, capable of delivering water at the temperature of either of the supply systems and at any temperature in between and suitable for controlling single or multiple outlets, as appropriate.

Controls: Incorporate the following:
- A temperature sensitive automatic control which maintains temperature at the pre-selected setting and rapidly shuts down the flow if either supply system fails or if the normal discharge water temperature is exceeded.
2.5 WATER HEATERS

Standard electric systems
Provide standard electrical water boilers as identified in the BOQ to locations identified on the drawings.

Solar water systems
Provide a proprietary automatic water heater comprising solar collector and storage container, with or without supplementary heating unit and including connections, controls and necessary fittings.

2.6 HOSE REELS

General
Provide hose reels with swivel hose guides in accordance with the Drawings.

2.7 STORMWATER

Cleaning
During construction, use temporary covers to openings and keep the system free of debris.

Downpipe connections
Turn up underground drainage pipelines to finish 50 mm above finished ground or pavement level.

Access Pits
Cover levels: Locate the top of covers or gratings, including frames as follows:
- In paved areas: Flush with the paving surface.
- In landscaped areas: 25 mm above finished surface.

Stormwater drains
Provide stormwater drains to connect downpipes, surface drains, subsoil drains and drainage pits to the outlet point or discharge point.

Downpipe connections: Turn up underground drainage pipelines with bends to meet the downpipe, finishing 50 mm (nominal) above finished ground or pavement level. Seal joints between downpipes and drains. Alternatively, terminate downpipe minimum of 100mm above adjacent ground level and discharge water to surface run off area. Allow for scour protection to bottom of downpipe.

Lined surface drains-grated trenches
Provide precast or cast in situ concrete lined trenches with painted or galvanized steel gratings.

2.8 SUBSOIL DRAINS

General
Provide subsoil drains to intercept groundwater seepage and prevent water build-up behind walls and under floors and pavements. Connect subsoil drains to surface drains or to the stormwater drainage system as applicable.

Connection: Connect subsoil drains to the stormwater drainage system.

Filters: UV resistant geotextile material with a permeability ≥ 10 times that of the native soil and capable of retaining particles of 0.25 mm size. Securely fit or join the sock at each joint.

Subsoil drains: Provide proprietary perforated plastic pipe.

2.9 SANITARY PLUMBING AND DRAINAGE

Vent pipes
Staying to roof: If fixings for stays penetrate the roof covering, seal the penetrations and make watertight.

Terminations: Provide bird-proof vent cowls of the same material and colour as the vent pipe.

Sanitary fixtures
Provide sanitary fixtures required, complete with all accessories necessary for correct installation and use.

2.10 COMPLETION

Testing
Hydrostatic tests: Do not install insulation until the piping has been tested. Pressure test cold and hot water services to ensure that all pipework is free from leaks. Include pipe joints, valve seats, tap washers and strainers. Repair as necessary, replace if damaged and retest.
Completion
Hot and cold water services: On completion, flush pipelines using water and leave them clean.
Stormwater and wastewater services: On completion, flush the system using water and leave clean.

Charging
On completion of installation, commissioning, and testing, fill the hot and cold water systems with water, turn on control and isolating valves and the energy supply and leave the water supply system in full operational condition.

Operation and maintenance manuals
Provide written operating and maintenance instructions containing:
- Contractor's contact details for service calls.
- Manufacturer's maintenance and operation literature.
- Description of day-to-day operation.

Record drawings
Provide a drawing of the system as installed. Show dimensions, types and location of the services in relation to permanent site features and other underground services. Include all changes made during commissioning and the maintenance period.

Diagrams: Include diagrammatic drawings of each system.

Services below ground: Where pipes and fittings are below ground show the depth and dimensioned references that will allow the future location of the service for maintenance or
9 ENVIRONMENTAL MANAGEMENT

9.0 PROTECTION OF ENVIRONMENT

The contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

During continuance of the contract, the contractor shall abide at all times by all existing enactments on environmental protection and rules made thereunder, regulations, notifications and bye-laws of the Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by Government or the local authority.

9.1 PREVENTION AND CONTROL OF WATER POLLUTION

9.1.1 Contamination of Ground and Surface Water
The contractor shall take all necessary precautions for the prevention and control of pollution of the ground and surface water from oil and waste oil spills, sanitary facilities, construction wastes, paints and any other chemicals used in the construction.

9.1.2 Drainage and Flood Control
Contractor shall take all necessary precautions to prevent the blockage of water flow from the construction materials like earth, stone, or appendage.
Stagnation of water within or outside the project area from the project activities should be avoided to prevent mosquito breeding and other vector borne diseases

9.1.3 Siltation of Water Bodies and Degradation of Water Quality
The Contractor will not excavate beds of any stream/canals/ any other water body for borrowing earth. The contractor shall ensure that construction materials containing fine particles are stored in an enclosure such that sediment-laden water does not drain into nearby water course.

9.2 PREVENTION AND CONTROL OF AIR POLLUTION

9.2.1 Transportation of Construction Materials
All vehicles delivering fine materials to the site shall be covered to avoid spillage of materials and dust generation. Photographic record of this activity should be maintained.

9.2.2 Vehicles, Equipment and Machinery
All vehicles, equipment and machinery to be used in the project should have pollution control equipment such as exhaust dispersion systems and silencers.

9.2.3 Dust Generation from Construction Site
Dust generation from the construction site should be minimized by Sprinkling water on the stock piles of wastes before loading for disposal and by covering the materials containing fine particles during the high winds
9.3 PREVENTION AND CONTROL OF NOISE POLLUTION
The quieter equipments available in the market shall be used in the Project. Diesel Generator Sets having acoustic enclosures shall be used for the project.

9.4 PREVENTION AND CONTROL OF SOIL POLLUTION

9.4.1 Control of Oil Spills
Contractor shall not carryout any vehicle/machinery maintenance on site to avoid contamination of ground. If the emergency maintenance is to be carried on site, proper collection and disposal systems should be arranged before carrying out the maintenance. In such cases the contractor should arrange for collection, storage and disposal of oil wastes generated during the emergency maintenance to the nearest work shop for further handling.

Contractor shall not dispose diesel, lubes, paints and any other materials on site which may contaminate the soil.

9.4.1 Demolition of Existing Structures
The contractor must recover all reusable materials generated from the demolition of the existing structures. All the reusable materials shall be reused in the project and unsuitable materials shall be disposed of as detailed in section 9.4.3.

9.4.2 Site Clearing
Topsoil generated from the clearing shall be preserved and reused in the landscaping of the project areas or can be spread in the borrow areas or disposed as directed by the Project Manager of UNOPS or his/her representative.

The contractor shall take reasonable precautions to minimize disturbance to the native flora during the construction.

9.4.3 Collection and Disposal of Solid Waste
The contractor shall develop a waste management plan within one week on arrival at site and the same shall be submitted to the Project Manager of the UNOPS or his/her representative. The contractor shall implement the waste management plan throughout the life of the Contract.

The plan should include collection, storage, transportation and disposal of wastes generated from all activities of the project. The following guidelines may be used for the safe solid waste management.

- Re usable materials should be used in the project as far as possible.
- Biodegradable materials shall be disposed in compost pits/ disposed away from the habitations
- Non biodegradable and non hazardous materials shall not be disposed on site and shall be disposed in a pit away from the habitation
- Deposit all indicated recyclable materials in the containers in a clean (no mud, adhesives, solvents, petroleum contamination), debris-free condition. Do not deposit contaminated materials into the containers until such time as such materials have been cleaned.
9.5 CONSTRUCTION MATERIALS

9.5.1 Construction Water
The contractor can use ground water/surface water as a source of water for the construction and he may set up own bore well facility for construction work or can take water from existing sources with written consent from owner of the bore well.

To avoid disruption/disturbance to other water users, the contractor will extract water from fixed location and details of the bore well will be recorded and filed.

If the new bore hole is created for the project water requirement, it should be left for the public use.

9.5.2 Coarse and Fine Aggregates
The contractor shall procure coarse and fine aggregates from the legal suppliers. The Contractor should obtain receipts of the purchase of materials and file copies of these receipts.

9.5.3 Soil
Deep borrow areas shall not be created for the project. Depth of the borrow area shall be limited to 60 cm. Top soil removed and preserved from the borrow area shall be spread after completion of borrowing of soil. The waste materials generated from the excavation should be disposed in borrow areas created for the project, if they are not suitable for the filling.

9.5.4 Wood
Wood/timber shall be obtained from the licensed suppliers and the receipt of purchase of wood/timber should be recorded.

9.6 HAZARDOUS WASTE

All the hazardous wastes shall be disposed of as specified by the supplier.

9.7 CLEANING OPERATION

On the completion of the construction, the contractor shall remove all waste materials and excess materials from the site to the satisfaction of the Project Manager of UNOPS or his/her representative.

9.8 PREVENTION AND CONTROL OF SPREAD OF COMMUNICABLE DISEASES, PARTICULARLY HIV/AIDS

The contractor shall provide HIV/AIDS/STDs awareness training to all the workers of the project. The contractor shall also provide strict guidelines regarding contact with local residences and enforce there guidelines.

9.9 CONSTRUCTION CAMP / SECURITY ROOM

The contractor shall provide proper water supply, cooking facilities, sanitation and solid waste collection and disposal systems to the construction camp / security room. The contractor shall preferably use unskilled labor drawn from local communities to give the maximum benefit to the local community to avoid impacts on the local environment.
The contractor shall set the guidelines prohibiting poaching and collection of plants/wood with meaningful consequences for violation such as termination of the employment.

9.10 REPORTING

The contractor shall submit solid waste management plan. This plan shall include collection, storage and disposal of solid waste generated from the Project.

The contractor should submit a completion report on the environmental management practices adopted on the completion of all site activities. This completion report shall include details of the difficulties faced and methods followed for overcoming these difficulties. The completion report should include photographic records and copies of agreements and receipts for materials.
10 SAFETY MANAGEMENT

10.0 CONSTRUCTION SAFETY

The contractor shall take all necessary steps to provide safety for project workers, the persons residing near the project, to the property of the public or others from the project activities arising as a consequence of his methods of operation.

The Contractor shall comply with all Safety Legislations and its Subsidiary Legislations, Regulations which are in force in the Country and any amendments or re-enactments.

The Contractor shall not permit any person to do anything not in accordance with the generally accepted principles of safe and sound practices. The Contractor shall ensure safe environment on site at all times. The Contractor shall ensure that necessary and sufficient precautions are taken by his workmen when safety provisions are used.

10.1 BARRICADING

The Contractor shall provide and maintain guards, fences or barriers around excavations, pits or other similar potential places of danger to prevent accidents. The barricade should be at least 1.1m high and strong enough to withstand a lateral point load of 50 kg.

10.2 WARNING SIGNS

The Contractor shall display warning signs of sizes 900 mm x 600 mm at a minimum of 4 points around the periphery of the site where the construction activities are located in near the residential area, roads, at locations where there is a chance of children can come to work site and where trespassing is likely to occur. Such signs shall have the words “DANGER - KEEP OUT OF SITE”

10.3 STORAGE OF FUELS

Fuels shall be stored in a room/ enclosed space, the room/ enclosed space shall have impervious platform and berm along the periphery of the storage area to contain spills of the fuels.

10.4 SAFETY OF MACHINERY

The Contractor shall employ only qualified operators for the machinery to be used on Site. All the machinery shall be locked when they are parked to avoid unauthorized operation of the machinery.

10.5 FIRST AID

At least two first aid kits shall be kept at site for attending the emergency treatment to the victims of accidents or chemical poisoning or excessive exposure to toxic substances. The first aid kit shall include a leaflet of standard First-Aid procedure in addition to the medicines and medical tools. At least one staff member who has undergone First Aid training should be posted at site.

10.6 FIRE SAFETY, EMERGENCY AND RESCUE

The Contractor shall establish Fire Safety, Emergency and Rescue arrangements to contain fire and take necessary action during emergency. The contractor should place fire extinguishers at the work site, materials storage area and at site accommodation. The contractor should keep minimum 6 fire extinguishers within the work place.
10.7 ELECTRICAL SAFETY

All electrical equipment should be listed and labeled, free from hazards, and used in the proper manner. The electrician should be protected from electrical shocks and provided necessary safety equipment.

All temporary electrical installations in the site should be verified regularly to ensure that all the leaks in the wires are rectified/ faulty wires are replaced. The contractor should also ensure that all electric joints are leak proof.

10.8 PERSONAL PROTECTIVE EQUIPMENT

The Contractor shall provide and maintain suitable personal protective equipment for all workmen employed on the site to provide protection against falling objects and harmful substances which can cause injury. The Personal protective equipment shall include boots, hand gloves, helmet and goggles. The Contractor shall record the issuance of all equipment to his workmen and kept in the site office.

10.9 HOUSEKEEPING

The Contractor shall provide safe working environment by keeping the site neat and tidy, and free from debris. All materials shall be stacked safely. All accesses shall be kept free from hazards and debris.

Housekeeping shall be carried out in such a manner and at such times so as not to cause any inconvenience to either the adjoining owners, occupiers or the public. Debris shall be wetted to minimize the risk of dust. Containers for debris, rubbish and other wastes shall be provided at the designated places.