PROJECT SPECIFICATION

Rehabilitation of Main (KABOUT) and WADI Lifting Sewage Pressure Stations, Sabratha City

UNDP Libya

2019

3.1 PRELIMINARIES

3.1.1 GENERAL

3.1.1.1 Pre-Construction Work

Notice to Proceed will be issued within 3 days after signing the contract. The contract period begins on the day the Notice to Proceed is issued.

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.

The contractor may not proceed with on-site mobilization or construction works before the Engineer approves the following documentation that shall be covered in Program:

- Condition-in Survey
- Site Survey
- Work Method Statement
- Program
- Quality Assurance / Quality Control Plan (QA/QC) as per minimum requirement 1.3 Contractor's Quality Control Plan specification.
- Health and Safety Plan (H&S) as per minimum requirement Health and Safety Specification no. 1.4.
- Environmental Protection Plan as per minimum requirement ...
- Dust and Noise Protection Plan
- Schedule of Materials and Installed Equipment

A Pre-Construction Meeting will be held between the Engineer and the Contractor to review the above documentation. If the documentation is incomplete, the Contractor will have 3 calendar days to revise and resubmit the documentation for approval.

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.

Access ways, 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.

3.1.1.2 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 is 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.

The Contractor will be required to comply to the approved Health and Safety Plan.

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.

3.1.1.3 Building the Works

Surveys

Setting out:	Set out the works from the dimensioned drawings
Check surveys:	Check the set out regularly on site
Final survey:	Confirm final set out 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. The Contractor shall check survey marks for consistency and if there are inconsistencies, the Contractor shall give written information to the Engineer with his proposed corrections. If the survey marks are damaged, the Contractor shall immediately advise the Engineer and rectify the damage.

Contractor's Representative

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

Program of Work

The Contractor is to provide a construction baseline program with MS Project which has the following information:

Sequence of Work. (Work Breakdown Structure)

Activity inter-relationships. (Should be closed loop)

Activity durations with start and finish dates

Periods within which various stages or parts of the work are to be executed.

Time scale: Calendar Days

Line items in program are to be based on UNDP Bill of Quantities numbering system (see index). Update the program weekly. Submit hardcopy and softcopy. Identify changes since the previous version, and show the actual starts and finishes, actual 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.

Items Supplied by Owner

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

3.1.1.4 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
- List of the suppliers with their contact information
- Spare materials, where applicable

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.

3.1.1.5 Payment for the works

Anticipated Progress Claims Schedule

The method of measurement and payment will be SMM7 – Standard Method of Measurement for Building Works (latest version).

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.

3.1.1.6 Miscellaneous

Compliance with the Law

The Contractor is responsible for compliance with all requirements of authorities. The owner, before entering into the contract, has given the notices, paid the fees, and obtained the permits, approvals and other authorisations stated in the **Prior Applications and Approvals schedule**.

3.2 GENERAL REQUIREMENTS

3.2.1 GENERAL

3.2.1.1 CONTRACT DOCUMENTS

Drawings

Large scale drawings take precedence over small scale drawings. Written or calculate able dimensions take precedence over scaled dimensions.

If there are any errors in dimensions, set out or size, immediately notify the Engineer.

Schedule

The schedule forms part of the specification. Information in the schedule will take precedence over information in the specification.

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.

3.2.1.2 INSPECTION

Inspection Notification Schedule

The Contractor is to notify the Engineer when the items identified in the **Inspection notification schedule** are ready for inspection.

Written 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.

3.2.1.3 SUBMISSIONS

Samples

The Engineer must approve the laboratory used for testing.

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.

3.2.2 PRODUCTS

3.2.2.1 TESTS

Notice

Give notice of time and place of nominated tests.

Attendance

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

The independent approved testing laboratory shall perform the required tests and report results of all tests noting if the tested material passed or failed such tests and shall furnish copies to the Engineer.

3.2.2.2 MATERIALS AND COMPONENTS

Consistency

For the whole quantity of each material or product use the same approved 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.

3.2.3 EXECUTION

Use of explosives will not be permitted.

3.2.3.1 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.

3.2.3.2 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.

Format – soft copy

- In PDF, Auto Cad or Microsoft Word, Excel format.

- On compact disk properly identified as above

Number of copes: 3.

3.3.1 GENERAL

When the specification requires a Contractor Quality Control Program, the Contractor shall establish, provide, and maintain an effective Quality Control Program that details the methods and procedures that will be taken to assure that all materials and completed construction required by this contract conform to contract plans, technical specifications and other requirements, whether manufactured by the Contractor, or procured from subcontractors or vendors. Although guidelines are established and certain minimum requirements are specified herein and elsewhere in the contract technical specifications, the Contractor shall assume full responsibility for accomplishing the stated purpose.

The intent of this section is to enable the Contractor to establish a necessary level of control that will:

a. Adequately provide for the production of acceptable quality materials.

b. Provide sufficient information to assure both the Contractor and the Engineer that the specification requirements can be met.

c. Allow the Contractor as much latitude as possible to develop his or her own standard of control.

The Contractor shall be prepared to discuss and present, at the preconstruction conference, his/her understanding of the quality control requirements. **The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the Quality Control Program has been reviewed by the Engineer.** No partial payment will be made for materials subject to specific quality control requirements until the Quality Control Program has been reviewed.

The quality control requirements contained in this section and elsewhere in the contract technical specifications are in addition to and separate from the acceptance testing requirements. Acceptance testing requirements are the responsibility of the Engineer.

3.3.2 DESCRIPTION OF PROGRAM.

General Description

The Contractor shall establish a Quality Control Program to perform inspection and testing of all items of work required by the technical specifications, including those performed by subcontractors. This Quality Control Program shall ensure conformance to applicable specifications and plans with respect to materials, workmanship, construction, finish, and functional performance. The Quality Control Program shall be effective for control of all construction work performed under this Contract and shall specifically include surveillance and tests required by the technical specifications, in addition to other requirements of this section and any other activities deemed necessary by the Contractor to establish an effective level of quality control.

Quality Control Program

The Contractor shall describe the Quality Control Program in a written document that shall be reviewed by the Engineer prior to the start of any production, construction, or off-site fabrication.

The Engineer will choose an adequate period for review. A minimum of 5 days before the preconstruction conference or the start of work is recommended.

Submittal of the written Quality Control Program prior to the preconstruction conference will allow the Engineer to review the contents and make suggestions at the preconstruction meeting.

Submittal of the written Quality Control Program prior to the start of work will allow for detailed discussion of the requirements at the preconstruction meeting. This will give the Contractor a better understanding of the requirements before developing the Quality Control Program.

When selecting the required days for the contractor to submit the Quality Control program, adequate time should be allowed for the Quality Control Program to be a supplement to the Owner's Construction Management Plan.

The Quality Control Program shall be organized to address, as a minimum, the following items:

a. Quality control organization;

b. Project progress schedule;

c. Submittals schedule;

d. Inspection requirements;

e. Quality control testing plan;

f. Documentation of quality control activities; and

g. Requirements for corrective action when quality control and/or acceptance criteria are not met.

The Contractor is encouraged to add any additional elements to the Quality Control Program that he/she deems necessary to adequately control all production and/or construction processes required by this contract.

3.3.3 QUALITY CONTROL ORGANIZATION

The Contractor Quality Control Program shall be implemented by the establishment of a separate quality control organization. An organizational chart shall be developed to show all quality control personnel and how these personnel integrate with other management/production and construction functions and personnel.

The organizational chart shall identify all quality control staff by name and function and shall indicate the total staff required to implement all elements of the Quality Control Program, including inspection and testing for each item of work. If necessary, different technicians can be utilized for specific inspection and testing functions for different items of work. If an outside organization or independent testing laboratory is used for implementation of all or part of the Quality Control Program, the personnel assigned shall be subject to the qualification requirements of paragraph 100-03a and 100-03b. The organizational chart shall indicate which personnel are Contractor employees and which are provided by an outside organization.

The quality control organization shall consist of the following minimum personnel:

a. Program Administrator: The Program Administrator shall be a full-time employee of the Contractor, or a consultant engaged by the Contractor. The Program Administrator shall have a minimum of 5 years of experience in building construction and shall have had prior quality control experience on a project of comparable size and scope as the contract.

Additional qualifications for the Program Administrator shall include at least 1 of the following requirements:

(1) Professional engineer with 1 year of building construction acceptable to the Engineer.

(2) Engineer-in-training with 2 years of building construction experience acceptable to the Engineer.

(3) An individual with 3 years of building construction experience acceptable to the Engineer, with a Bachelor of Science Degree in Civil Engineering, Civil Engineering Technology or Construction.

(4) Certified Construction materials technician

The Program Administrator shall have full authority to institute any and all actions necessary for the successful implementation of the Quality Control Program to ensure compliance with the contract plans and technical specifications. The Program Administrator shall report directly to a responsible officer of the construction firm.

The Engineer may require a full time, on-site Program Administrator, should the project be of sufficient scope and size.

b. Quality Control Technicians. A sufficient number of quality control technician's necessary to adequately implement the Quality Control Program shall be provided. These personnel shall be either engineers, engineering technicians, or experienced craftsman with qualifications in the appropriate field higher construction materials technician and shall have a minimum of 2 years of experience in their area of expertise.

The quality control technicians shall report directly to the Program Administrator and shall perform the following functions:

(1) Inspection of all materials, construction, plant, and equipment for conformance to the technical specifications, and as required by Section 1.3.6

(2) Performance of all quality control tests as required by the technical specifications and Section 100-07.

c. Staffing Levels. The Contractor shall provide sufficient qualified quality control personnel to monitor each work activity at all times. Where material is being produced in a plant for incorporation into the work, separate plant and field technicians shall be provided at each plant and field placement location. The scheduling and coordinating of all inspection and testing must match the type and pace of work activity. The Quality Control Program shall state where different technicians will be required for different work elements.

3.3.4 PROJECT PROGRESS SCHEDULE

The Contractor shall submit a coordinated construction schedule for all work activities. The schedule shall be prepared as a network diagram in Critical Path Method (CPM), PERT, or another format, or as otherwise specified in the contract. As a minimum, it shall provide information on the sequence of work activities, milestone dates, and activity duration. Ms Project and soft copy has to be submitted.

The Contractor shall maintain the work schedule and provide an update and analysis of the progress schedule on a twice monthly basis, or as otherwise specified in the contract. Submission of the work schedule shall not relieve the Contractor of overall responsibility for scheduling, sequencing, and coordinating all work to comply with the requirements of the contract.

3.3.5 SUBMITTALS SCHEDULE

The Contractor shall submit a detailed listing of all submittals (e.g., mix designs, material certifications) and shop drawings required by the technical specifications. The listing can be developed in a spreadsheet format and shall include:

a. Specification item number;

b. Item description;

c. Description of submittal;

d. Specification paragraph requiring submittal; and

e. Scheduled date of submittal.

3.3.6 INSPECTION REQUIREMENTS

Quality control inspection functions shall be organized to provide inspections for all definable features of work, as detailed below. All inspections shall be documented by the Contractor as specified by Section 1.3.7.

Inspections shall be performed daily to ensure continuing compliance with contract requirements until completion of the particular feature of work. These shall include the following minimum requirements:

a. During plant operation for material production, quality control test results and periodic inspections shall be utilized to ensure the quality of aggregates and other mix components, and to adjust and control mix proportioning to meet the approved mix design and other requirements of the technical specifications. All equipment utilized in proportioning and mixing shall be inspected to ensure its proper operating condition. The Quality Control Program shall detail how these and other quality control functions will be accomplished and utilized.

b. During field operations, quality control test results and periodic inspections shall be utilized to ensure the quality of all materials and workmanship. All equipment utilized in placing, finishing, and compacting shall be inspected to ensure its proper operating condition and to ensure that all such operations are in conformance to the technical specifications and are within the plan dimensions, lines, grades, and tolerances specified. The Program shall document how these and other quality control functions will be accomplished and utilized.

3.3.7 QUALITY CONTROL TESTING PLAN

As a part of the overall Quality Control Program, the Contractor shall implement a quality control testing plan, as required by the technical specifications. The testing plan shall include the minimum tests and test frequencies required by each technical specification Item, as well as any additional quality control tests that the Contractor deems necessary to adequately control production and/or construction processes.

The testing plan can be developed in a spreadsheet fashion and shall, as a minimum, include the following:

a. Specification item number (e.g., P-401);

b. Item description (e.g., Plant Mix Bituminous Pavements);

c. Test type (e.g., gradation, grade, asphalt content);

d. Test standard (e.g., ASTM or AASHTO test number, as applicable);

e. Test frequency (e.g., as required by technical specifications or minimum frequency when requirements are not stated);

f. Responsibility (e.g., plant technician); and

g. Control requirements (e.g., target, permissible deviations).

The testing plan shall contain a statistically-based procedure of random sampling for acquiring test samples in accordance with ASTM D 3665. The Engineer shall be provided the opportunity to witness quality control sampling and testing.

All quality control test results shall be documented by the Contractor as required by Section 1.3.8.

3.3.8 DOCUMENTATION

The Contractor shall maintain current quality control records of all inspections and tests performed. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken.

These records must cover both conforming and defective or deficient features and must include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records shall be furnished to the Engineer daily. The records shall cover all work placed subsequent to the previously furnished records and shall be verified and signed by the Contractor's Program Administrator.

Specific Contractor quality control records required for the contract shall include, but are not necessarily limited to, the following records:

a. Daily Inspection Reports. Each Contractor quality control technician shall maintain a daily log of all inspections performed for both Contractor and subcontractor operations on a form acceptable to the Engineer. These technician's daily reports shall provide factual evidence that continuous quality control inspections have been performed and shall, as a minimum, include the following:

(1) Technical specification item number and description;

(2) Compliance with approved submittals;

(3) Proper storage of materials and equipment;

(4) Proper operation of all equipment;

(5) Adherence to plans and technical specifications;

(6) Review of quality control tests; and

(7) Safety inspection.

The daily inspection reports shall identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed.

The daily inspection reports shall be signed by the responsible quality control technician and the Program Administrator. The Engineer shall be provided at least one copy of each daily inspection report on the work day following the day of record.

b. Daily Test Reports. The Contractor shall be responsible for establishing a system that will record all quality control test results. Daily test reports shall document the following information:

(1) Technical specification item number and description;

(2) Test designation;

(3) Location;

(4) Date of test;

(5) Control requirements;

(6) Test results;

(7) Causes for rejection;

(8) Recommended remedial actions; and

(9) Retests.

Test results from each day's work period shall be submitted to the Engineer prior to the start of the next day's work period. When required by the technical specifications, the Contractor shall maintain statistical quality control charts. The daily test reports shall be signed by the responsible quality control technician and the Program Administrator.

3.3.9 CORRECTIVE ACTION REQUIREMENTS

The Quality Control Program shall indicate the appropriate action to be taken when a process is deemed, or believed, to be out of control (out of tolerance) and detail what action will be taken to bring the process into control. The requirements for corrective action shall include both general requirements for operation of the Quality Control Program as a whole, and for individual items of work contained in the technical specifications.

The Quality Control Program shall detail how the results of quality control inspections and tests will be used for determining the need for corrective action and shall contain clear sets of rules to gauge when a process is out of control and the type of correction to be taken to regain process control.

When applicable or required by the technical specifications, the Contractor shall establish and utilize statistical quality control charts for individual quality control tests. The requirements for corrective action shall be linked to the control charts.

3.3.10 SURVEILLANCE BY THE ENGINEER

All items of material and equipment shall be subject to surveillance by the Engineer at the point of production, manufacture or shipment to determine if the Contractor, producer, manufacturer or shipper maintains an adequate quality control system in conformance with the requirements detailed herein and the applicable technical specifications and plans. In addition, all items of materials, equipment and work in place shall be subject to surveillance by the Engineer at the site for the same purpose.

Surveillance by the Engineer does not relieve the Contractor of performing quality control inspections of either on-site or off-site Contractor's or subcontractor's work.

3.3.11 NONCOMPLIANCE.

The Engineer will notify the Contractor of any noncompliance with any of the foregoing requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Any notice, when delivered by the Engineer or his/her authorized representative to the Contractor or his/her authorized representative at the site of the work, shall be considered sufficient notice.

In cases where quality control activities do not comply with either the Contractor Quality Control Program or the contract provisions, or where the Contractor fails to properly operate and maintain an effective Quality Control Program, as determined by the Engineer, the Engineer may:

(1) Order the Contractor to replace ineffective or unqualified quality control personnel or subcontractors.

(2) Order the Contractor to stop operations until appropriate corrective actions are taken.

3.4 HEALTH AND SAFETY

3.4.1 GENERAL

3.4.1.11.1 Responsibility for Safety

The contractor shall be responsible for the safety of all operations in connection with the Contract and shall take all necessary actions and precautions to ensure the safety of all persons who may be in, on or adjacent to the Site.

3.4.1.2 Compliance with UNDP Workplace Safety and Health Policy & Procedures

The Contractor shall comply with the compliance with the UNDP Workplace Safety and Health Policy & Procedures for the purposes of this clause including all sub clauses under it) and any amendment or re-enactment thereto and including but not limited to:

Any other rules and regulations, Standards and Codes of Practices related and relevant to the promotion of safe practices and conduct at the worksite.

It shall be the duty of the Contractor to comply with all such requirements of the Workplace Safety and Health Policy & Procedures, as affect him or any person or persons employed by him, and as related to any work, act or operation performed or about to be performed by him. 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 a safe environment on the site at all times. All safety provisions shall be properly maintained and shall not be removed. The Contractor shall ensure that necessary and sufficient precautions are taken by his workmen when safety provisions are used. The Contractor shall not allow any of the safety provisions to be used unless he has satisfied himself that the provisions are safe.

Where UNDP Project Manager appoints an engineer to carry out any work for any temporary works specified below, the engineer shall comply with any duties imposed on him under those regulations:

1) Cantilevered platforms erected more than 3m above ground;

2) Formwork structure;

3) Runway and ramp for use of motor trucks or heavy vehicles;

4) Stability of structure adjacent to excavation;

5) Shoring and bracing for trench excavation > 4m; and

Duties on engineers undertaking temporary works regulated by UNDP Health & Safety Policy & Procedures:

a) Design it to acceptable codes and standards and in accordance with good engineering practices;

b) Ensure that it is constructed accordance with his design;

c) When it is constructed, satisfy himself that it is safe for its intended use and if so, issue a certificate stating that it is safe for its intended use;

d) The engineer shall exercise due diligence when carrying out his duties; and

The Contractor shall ensure that the requirements of Health & Safety Policy & Procedures and the requirements specified hereunder are strictly complied with at all times.

3.4.1.3 Undertaking by Contractor

The Contractor shall undertake to ensure that the provisions of the Health & Safety Policy and Procedures are complied with. The attached safety provisions undertaking form for the Occupier/Contractor in **"Appendix I**" shall be complied by a Managing Director or other duly authorized representative of the company/firm awarded the Contract.

3.4.1.4 Site Safety Programme

The Contractor shall not begin any construction or production of materials to be incorporated into the completed work until the Contractor's Health and Safety Plan has been reviewed by UNDP. The relevant safety equipment and safe method of work employed at each stage of construction shall be described in detail. Special risks involving specialized equipment shall also be highlighted. The programme shall also include company safety policy, risk assessment, safety rules and regulations, small group activities, safety promotion programme (safety slogans, safety campaign, slide shows etc), safety training, emergency procedures and other such activities. The safety programme must be displayed outside the site office. The Contractor shall display safety posters at the site office, site canteen, exit/entry points of buildings and passenger cum material hoist area.

3.4.1.5 Monthly Safety Review

The Contractor shall carry out monthly safety review of the measures contained within the Safety Programme to demonstrate that the required level of safety is being achieved and maintained and make a full report to UNDP on each such review. UNDP will review the Safety Programme from time to time and will advise the Contractor of any matter with which he is not satisfied and the Contractor shall take such steps as are necessary to satisfy UNDP. UNDP will carry out such safety studies or audits, as considered necessary. The Contractor shall make available, specialist personnel as the UNDP may consider necessary for the performance of such safety studies or audits.

3.4.1.6 Risk Management

The contractor shall conduct a risk assessment in relation to the safety and health risks posed to any person who may be affected by his undertaking prior to the commencement of work in accordance to UNDP Health and Safety Policy & Procedures

The contractor shall take all reasonably practicable steps to eliminate any foreseeable risk to any person who may be affected by his undertaking.

The contractor shall maintain a record of risk assessments conducted, including any control measures taken or to be taken and any safe work procedures.

The contractor shall ensure that his employees are informed of the nature of the risk involved, the measures implemented to control the risk and applicable safe work procedures. Whenever the assessment of a risk is revised, or where control measures or safe work procedures are changed, employer shall inform employees of such changes.

3.4.2 SITE SAFETY MEASURES

3.4.2.1 Physical Measures

The contractor must develop procedures in a fall protection plan for the construction site if his worker at the work site may fall 3 metres or more and the worker is not protected by guardrails.

The contractor must have a fall protection system in place and available at the construction site before work with a risk of falling begins.

The contractor must have the following devices and system in place prior to start of the work:

(i) fall arresting devices such as rope grabs, guard rails etc

(ii) safety belts, body harness, lanyards consisting of carabiners, D-rings, O-Rings, ovals rings, self-locking connectors and snap hooks

3.4.2.2 Metal Access Scaffold and Working Platforms

The Contractor shall provide, erect and maintain metal access scaffold for all building blocks of 2 storey and above or 3.0 m in height and above.

The scaffold shall be erected ahead of the structural work from the second storey and supported by cantilevered platforms erected according to the reasonable safety standards. The cantilevered platforms shall project about 1.1m from the edge of the building or any other distance. The scaffold shall be erected within 300mm from the building edge. Where the structure does not allow the scaffold to be erected from the second storey or where the building is less than 12.0m in height, the Contractor may erect the scaffold from the first storey subject to review by UNDP.

The Contractor and his Engineer shall ensure that the building structure can resist the load imposed by the scaffold. The scaffold shall be designed to carry metal working platforms and two working levels in use concurrently. The maximum average loading per working level per bay is 220 kg per m^2. Signboards showing the maximum loading allowed on the scaffold may be displayed on the scaffold.

The Contractor shall provide, erect and maintain continuous metal work platforms or other types of work platforms at every alternate lift starting from the 2^{ND} lift of the scaffold, the immediate level below the top most level and the roof level of the building block under construction.

Where the height between the work platform at the roof level and the platform directly below is two lifts or less, the latter work platform may not be necessary. No omission from the Contract Sum shall be made in the event that such a work platform is not necessary.

The material used for the metal work platform shall be steel. Work platforms shall be adequately secured to scaffolding frames at the required levels. The connections between work platform and scaffolding frame, and between the work platforms shall be subject to review by UNDP.

For any portion of the work platform where the use of metal is not suitable, the Contractor may use timber platform subject to the review by the SO. The platform shall be completing with at least 90 mm high coloured toe boards and metal guardrails at least 1.0 m above the work platform.

The work platform shall be at least 500mm in width. The platform shall be used for:

(i) Erecting and dismantling of formwork of structural elements;

(ii) Transferring of formwork or other materials from one working level to another; and

(iii) External finishing works.

The Contractor shall provide, erect and maintain an overlying screening net to cover the entire external face of the scaffold. The installation of the net shall follow the erection of the scaffold closely. A 90mm high coloured toe board shall be provided at the base of the net. After installation, there shall be no opening between separate sets of the net and any torn net shall be replaced or repaired immediately. The scaffold shall be effectively tied to the building structure by means of tie-backs. All tie-backs shall be painted with bright colour for easy identification.

For buildings, next to areas less than 30m away from the Site boundary, the Contractor shall provide special mid-height platform supporting metal access scaffold at the building elevation directly facing public areas, walkways, children playgrounds, schools and other locations with public traffic.

The special mid-height work platform shall be installed from the floor level at the mid height of the building and shall project 6m from the edge of the floor. They shall be supported at the floor level below by diagonal members. Tension tie backs to upper floors shall not be used.

Around the edges of the 6m platform, guardrails and toe boards shall be provided. Guardrail shall have sufficient strength and rigidity to withstand, without permanent deformation or failure, a 50 kg loads applied in any direction at right angles to the guardrail.

The work platform and its supports shall be designed by an Engineer to a uniformly distributed live load of 1.5 kg per m^2 and the loading from the scaffold. Supports for platform shall be spaced at not more than 1.8m centre to centre.

3.4.2.3 Personal Protective Equipment

The Contractor shall provide and maintain suitable personal protective equipment for all workmen employed on the Site.

- The Personal Protective Equipment consists of the following:
- Hearing protection equipment such as ear defenders, ear plugs etc. (where required)
- Eye protection such as safety eye wear, welding goggles and shields etc.
- Foot protection such as safety shoes/boots etc.
- Head protection such as hard hats
- Limb and body protection such as gloves, reflective vests etc.
- Respirators, as necessary and adequate

The Contractor shall ensure that such personal protective equipment comply with the requirements of UNDP.

The Contractor shall also ensure that all equipment is properly used by his workmen during the course of their work. The Contractor shall record the issuance of all equipment to his workmen in the prescribed forms and such forms shall be kept in the site office and made available for inspection at all times.

3.4.2.4 Overhead Shelters

The Contractor shall provide, erect and maintain overhead shelters at every point of entry/exit of buildings two or more storey in height. The overhead shelters shall be constructed immediately below the second storey. The overhead shelters shall project at least 3.0m from the building edge and shall be at least 1.5m wide. The overhead shelters shall be made of curved metal roofing with a diameter of at least 1.5m or pitched metal roofing with a slope greater than one in two, with timber boarding below supported by steel pipes resting on rigid bases.

The access to, along and egress from the entry/exit points shall be kept free from obstructions and accumulation of oil, grease, water and other substances that may cause slipping and tripping.

Overhead shelters shall also be provided for person(s) exposed to falling objects.

3.4.2.5 Peripheral Overhead Shelters

The Contractor shall provide peripheral overhead shelters for buildings of 15.0m or more in height. It shall be erected in place when the construction reaches the third storey slab. The overhead shelter shall be at least 2.0m wide, and inclined so that the outer edge is at least 150mm higher than the inner edge. The overhead shelter shall be sufficiently strong to support a weight of at least 75 kg point load.

3.4.2.6 Barricades to Lift Openings, Voids, Open Sides of Buildings and Excavations

The Contractor shall barricade all lift openings, internal voids, open sides of buildings and excavations where a person is liable to fall. The barricade shall be at least 1.1m high and shall have sufficient strength and rigidity to withstand a lateral point load of 50 kg.

3.4.2.7 Suspended Scaffolds

A suspended scaffold system shall only be used for touching up, repair and redecoration and minor work. Where suspended scaffold system is to be used, the Contractor shall notify UNDP prior to its installation and usage. The safe working load will be prominently displayed. The Contractor shall ensure that there are weekly checks and additional check after inclement weather by his supervisor and monthly check by an Engineer (Civil). Where the use of access scaffolding is not stipulated, suspended scaffold may be used for finishing works. Independent lifelines shall be provided for suspended scaffold riggers and users to anchor their safety harness attached with shock absorbing device.

3.4.2.8 Ladders

The Contractor must ensure that ladders are in an acceptable sound condition and submit a written inspection report to UNDP.

If the ladder is made of a material other than steel, the contractor must ensure that the ladder is in sound condition.

If the ladder is constructed of lumber/timber, the contractor must ensure that the timber is free of loose knots or knot holes, must not have a split and must be strong and sturdy.

The contractor's worker must ensure that:

- the ladder is secured against movement and placed on a base that is stable
- the base of an inclined ladder is no further from the base of the wall or structure than 1.4 of the height to where the ladder contacts the wall or structure.

3.4.2.9 Mobile Cranes

No person shall install, repair, alter or dismantle a mobile crane unless he is an approved mechanic. The contractor/mechanic shall ensure, so far as is reasonably practicable, that the mobile crane is erected, installed or modified in such a manner that it is safe, and without risk to health, when properly used.

The Contractor shall ensure that the crane access is properly constructed and weekly check by supervisor is carried out. The boom of the mobile crane with hoisted load shall not be allowed to swing outside the contract boundary without the review by UNDP. All hoisting areas must be effectively barricaded.

The Contractor shall ensure there is installation of barriers to warn the crane operator of depressions, excavated areas and other obstructions.

The Contractor shall station a lifting supervisor on the Site to oversee and guide the crane operator during positioning, hoisting and slewing. The Contractor shall ensure daily checks are carried out by the crane operator. The cranes must have overhaul checks before being used on the Site.

3.4.2.10 Temporary Chute for The Removal of Construction Debris

The Contractor shall provide adequate number of temporary chutes to dispose construction debris from the upper story of all building blocks 2 story and above. It shall be erected to follow the structural work. A large bin at the lower end of each chute shall be provided and emptied regularly. "**DANGER - KEEP OUT**" in the official languages shall be posted at the bin area.

3.4.2.11 Warning Signs and Lights

The Contractor shall display warning signs of sizes 900 mm x 600 mm at strategic points around the periphery of the Site where trespassing is likely to occur. Such signs shall have the words "**DANGER - KEEP OUT**" in the two languages (Dari & English) painted in red on a white background in gloss finishing paint. Warning lights shall be placed at similar positions at night to serve as warnings.

3.4.2.12 Housekeeping

The Contractor shall maintain and ensure a safe working environment by keeping the Site neat and tidy, and free from hazards and debris. Materials shall be stacked up safely. All work areas and access thereto 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 occupiers or the public. Debris shall be wetted to minimize the risk of dust. Containers for debris and rubbish are to be provided at the designated places.

3.4.2.13 Temporary Staircases

The Contractor shall provide and maintain a minimum 0.8m wide temporary metal staircase from one working floor to another. The staircase shall be placed against the adjacent staircase wall or formwork of the staircase walls that are under construction. The outer sides of the staircases shall be provided with metal handrails 1.1m above the outer staircase strings. The bottom of the staircase shall be covered fully with metal plate.

3.4.2.14 Safety Information Signboard and Assembly Stage

The Contractor shall erect and maintain a Safety Information Signboard and Assembly Stage. The signboard shall be 6.0m x 3.0m, made of timber plywood and fixed at a steel frame. The signboard shall consist of safety posters, safety theme and pictures, safety news, photos of good safety measures, one 600mm x 1500mm mirror. The safety posters, news and photos shall be protected from weather.

The arrangement and size of display of all items referred herein shall be submitted to the UNDP. The stage shall be constructed in front of the signboard and made of concrete. The stage shall consist of a raised platform of 4.5m x 1.0m with at least one step.

The location of the signboard and stage shall be review by UNDP. As and when instructed by UNDP, the Contractor shall remove or relocate and reconstruct the signboard and stage and reinstate all the affected ground to the satisfaction of UNDP, all at the cost and expense of the Contractor. On Substantial Completion of the Works, the signboard and stage shall be cleared away upon the review of UNDP.

3.4.2.15 Gas Cylinders and Related Equipment

The Contractor shall use gas cylinders, each fitted with a low-pressure gauge, a high-pressure gauge, a reducing valve with pressure regulator, and a safety relief device. The gas cylinders shall not be kept in the same room where welding, cutting or heating is being carried out or placed within five metres of any source of heat. The gas cylinders must always be kept upright in a wheeled-trolley. When lifted by crane, hoist or derrick, cylinders must be placed in cradles or skip box design. Protective valve caps shall also be in place.

The hose connecting a gas cylinder to an apparatus for cutting, welding, heating or other related works shall be of good construction and sound material, free from defect, properly maintained, and not entangled or kinked. Valves and fittings shall be tested for leak with "soap water" every day before use.

3.4.2.16 Safety Reflective Apparel (Traffic Control)

A worker designated to control traffic shall wear approved type of reflective apparel during all hours of the day when so engaged.

3.4.2.17 Health Measures

Noise Management

The contractor shall as far as practicable, ensure that all processes, machines and equipment used, do not cause workers to be exposed to excessive noise, i.e. above an equivalent sound level of 85 dBA for 8-hour workday. This can be done by implementing one or more of the following measures:

- Engineering noise control, e.g., modifying noisy processes, machines and equipment, relocating noisy processes or isolating them within enclosures, erecting sound barriers, reducing kinetic or potential energy and regularly maintaining machines and equipment;
- Administrative noise control, e.g., rotating noisy jobs among workers so that they are not exposed to noise above the permissible exposure limit;
- Using quiet machines and equipment when such machines and equipment are available in the market. Examples are generators, compressors and concrete breakers. The contractor shall provide hearing protectors for workers who are exposed to excessive noise and ensure that they are worn at all times. Warning signs to remind workers that hearing protectors must be worn shall be put up at areas with excessive noise.
- Contract workers should be trained and educated on the hazards of noise, noise control and the prevention.

First-Aid

All workplaces as specified within the class or description shall establish and implement a first-aid programme to provide emergency treatment to victims of accidents, chemical poisoning or excessive exposure to toxic substances.

The programme shall include: -

• First-aid facilities;

• First-aid boxes;

• First-aid room, where there are 500 or more workers at site;

• First-aid treatment procedures;

• First aid for exposure to toxic or corrosive substances

• Standard procedures;

• Maintenance of first-aid facilities.

All first-aid provisions shall comply with the UNDP Health & Safety (First-Aid) Regulations.

3.4.2.18 Electrical Works

Where work to be carried out involves electricity/power, installing temporary wiring, usage of power tools and equipment, no worker shall connect, maintain or modify electrical tools, equipment or installation unless the worker is a qualified electrician.

The contractor shall take every reasonable precaution to prevent hazards to workers from energized electrical equipment, installations and conductors

No person, other than a person authorized to do so by the contractor of the project, shall enter or be permitted to enter a room or other enclosure containing exposed energized electrical parts.

The entrance to a room or other enclosure containing exposed energized electrical parts shall be marked by conspicuous warning signs stating that entry by unauthorized persons is prohibited.

All electrical equipment, installations, conductors and insulating materials shall be suitable for their intended use and shall be installed, maintained, modified and operated so as not to pose a hazard to a worker.

Contractor shall use mats, shields or other protective devices or equipment, including personal protective equipment, adequate to protect the worker from electrical shock and burns.

3.4.2.19 Work in Confined Space

Where work is to be carried out in any confined space as defined in UNDP, code of practice for entry into and safe working in confined spaces shall be followed.

3.4.2.20 Excavations and Tunnels

No person shall enter or be permitted to enter an excavation that does not comply with this Part.

Work shall not be performed in a trench unless another worker is working above ground in close proximity to the trench or to the means of access to it.

The type of soil in which an excavation is made shall be determined by visual and physical examination of the soil,

(a) at the walls of the excavation; and

(b) within a horizontal distance from each wall equal to the depth of the

excavation measured away from the excavation.

Before an excavation is begun,

(a) gas, electrical and other services in and near the area to be excavated shall

be accurately located and marked; and

(b) if a service may pose a hazard, the service shall be shut off and disconnected.

An excavation in which a worker may work shall have a clear work space of at least 450 mm between the wall of the excavation and any formwork or masonry or similar wall.

The walls of an excavation shall be stripped of loose rock or other material that may slide, roll or fall upon a worker.

A level area extending at least one metre from the upper edge of each wall of an excavation shall be kept clear of equipment, excavated soil, rock and construction material.

The stability of a wall of an excavation shall be maintained where it may be affected by stockpiling excavated soil or rock or construction materials.

No person shall operate a vehicle or other machine and no vehicle or other machine shall be located in such a way as to affect the stability of a wall of an excavation.

If a person could fall into an excavation that is more than 2.4 metres deep, a barrier at least 1.1 metres high shall be provided at the top of every wall of the excavation that is not sloped.

Where the excavation is a trench and the depth exceed six metres or the width exceeds 3.6 metres, a support system shall be consisting of either timber or of an engineered support system designed for the specific location and project shall be installed.

3.4.2.21 Control of Traffic

If vehicle traffic at the construction site is dangerous to workers, pedestrians, school children on foot, the contractor and his workers must ensure that the traffic movement is controlled to protect against accident related injuries and fatalities.

The contractor must designate a worker to control traffic on the construction site, the contractor must ensure that the designated traffic controller wears a reflective vest, safety footwear and hard hat.

The passage of vehicles across a footpath shall be supervised to remove danger to the school children and the public.

The contractor and his workers must be vigilant at all times and must ensure that pedestrians and school children **DO NOT** cross the safety barriers and enter the construction site.

3.4.2.22 Others

The Contractor shall provide and maintain guards, fences or barriers around the construction site, excavations, lift pits or other similar potential places of danger to prevent accidents. The guards, fences and barriers shall be of sound material, good construction and possess adequate strength.

3.4.3 NON-COMPLIANCE WITH CONTRACT SAFETY SPECIFICATIONS

In the event of contravention or non-compliance with the safety specifications, UNDP shall suspend the progress of works or any part of them if necessary for the safety of the works or if he is of the opinion that the working environment or procedure is unsafe for the works to continue. In such event, the Contractor shall not be entitled to any claims for compensation or extension of time for completion.

Appendix I

Form for Undertaking Safety Provision by Contractor

Project Manager

United Nations Office for Project Services

Kabul Schools Project

Copy: UNDP Health & Safety Officer

RE: SAFETY PROVISIONS AT

_____

_____

_____

I, _____ of _____

(Name of Managing Director) (Name of Company)

I/C No:_____ understand that as the Contractor of /for the above worksite / work area or order, it is my duty and responsibility to ensure that the provisions of UNDP Health & Safety Policy & Procedures, and any amendments or re-enactments thereto are complied with.

_____

(Managing Director) (Signature)

_____

(Name of Company / Company Stamp) (Date)

3.5 ENVIRONMENTAL IMPACTS AND RECOMMENDED MITIGATION MEASURES

3.5.1 GENERAL

Project works are to be assessed by UNDP to identify any significant impacts on environmental or social characteristics of the project area. This notwithstanding, some impact can be expected to occur during the course of construction activities. These impacts can be appropriately managed or mitigate by the measures contained in the following environmental mitigation list.

3.5.2 CLIMATE AND AIR QUALITY

Impacts to local air quality during construction can be anticipated due to fugitive dust generation in and around the construction area. Mitigation measures shall be implemented to avoid any significant impact.

Construction activities will also result in the generation of diesel exhaust from heavy equipment and generators. Following mitigation measures shall be implemented to avoid any significant impact:

3.5.2.1 Mitigation 1

The generation of dust during construction shall be mitigated through avoidance strategies as follow:

- Subcontractor shall be required to spray water during windy conditions.
- Trucks carrying earth, sand or stone shall be covered to avoid spilling.
- Open burning shall be prohibited on the construction sites.

3.5.2.2 Mitigation 2

The generation of diesel exhaust emissions during construction shall be mitigated through avoidance strategies as follows:

- All equipment shall be in good operating condition.
- Machinery shall not be left idling unless necessary during winter operations.

3.5.3 SURFACE WATER

Construction activities can result in increased turbidity of runoff water due to soil erosion. Mitigation measures shall be implemented to avoid any significant impact.

Construction activities can also result in contamination of runoff due to leaking fuel or lubricants from construction equipment. Mitigation measures shall be implemented to avoid any significant impact.

Construction of the facilities will result in an increase in hardscaping, with a resulting incremental increase in surface water runoff. If minor paving is planned, then little runoff will leave the construction site and may not impact on surrounding drainages.

To avoid significant impacts following mitigations shall be implemented:

3.5.3.1 Mitigation 1

Impacts due to soil erosion shall be mitigated by careful grading of the construction site such that significant amounts of water is not allowed run off of the construction site into adjacent drainages.

Where excavated soils are stored on site, adequate measures shall be implemented to control runoff, including covering exposed soils, construction of settling basins, or erection of physical barriers.

3.5.3.2 Mitigation 2

Machinery and equipment shall be maintained in good working condition and shall be regularly inspected for leaks. Any maintenance of equipment or machinery onsite could only occur over non-permeable areas with adequate containment measures to capture spills.

Fuel storage shall be provided with adequate containment measures to capture spills.

3.5.4 GROUNDWATER

Construction activities can result in contamination of runoff due to leaking fuel or lubricants from construction equipment. *1.5.3.2 Mitigation 2* will also prevent groundwater contamination.

Construction of the facilities will result in an increase in hardscaping resulting in an incremental decrease in groundwater percolation. If minor paving is planned, it may not decrease and will not impact on groundwater supplies. In most cases *1.5.3.1 Mitigation 1* will prevent groundwater contamination.

3.5.5 TERRESTRIAL ECOLOGY

If the project site is urban site and is with no natural habitats or significant natural flora or fauna, then no impacts are anticipated and no mitigation measures will be required. Otherwise the subcontractor shall contact UNDP for mitigation measures requirement policy and guidance prior to commencing site works.

3.5.6 SOCIOECONOMICS

Construction of projects, depending to the type of the project, will result in a significant number of construction jobs. Employment will result in multiplier effects by generating commerce with benefits provided throughout the local economy.

If the program includes capacity building component, which will promote on-the-job skills training in construction methods, quality control, and/or construction safety, the skill transfer will result in improved capacity of local contractors to successful undertake future construction projects.

Improved and expanded educational facilities will result in improved learning opportunities and provide long-term benefits to the local economy.

In such cases, the following mitigations shall be implemented:

3.5.6.1 Mitigation 1

The program shall include capacity building, including classroom and on-the-job training, in construction methods, quality control, and construction safety.

3.5.6.2 Mitigation 2

The use of local subcontractors shall be encouraged wherever possible.

3.5.7 TRAFFIC AND TRANSPORTATION

Construction activities will result in additional truck traffic and potential traffic congestion on local streets, depending on the site location. The truck traffic will also result in potential threats to pedestrian safety. Following mitigation measures shall be implemented to avoid any significant impact if the project site is in urban:

Note: Operational impacts may need to be assessed should construction activities alter the current usage of the sites or traffic flow patterns.

3.5.7.1 Mitigation 1

Delivery of materials and equipment to the site shall be scheduled during periods of light traffic (e.g. early morning or late afternoon).

3.5.7.2 Mitigation 2

Where necessary, pedestrian access-way improvements shall be provided prior to commencing construction activities. These improvements could include sidewalks, fencing, or alternate routes.

3.5.7.3 Mitigation 3

The construction contractor shall provide flag men and other traffic control measures to avoid conflicts between construction traffic and other vehicles and /or pedestrians.

3.5.8 VISUAL QUALITY

Construction activities may result in a short-term impact to the visual quality of buildings. In particular, buildings in progress are generally stark in appearance. Additionally, construction material and wastes may result in a cluttered site. Following mitigation measures shall be implemented to avoid any significant impact on this issue:

3.5.8.1 Mitigation 1

The subcontractor shall be required to maintain a site free from rubbish. The contractor shall be required to conduct regular housekeeping to include removal of rubbish, construction waste, and proper storage of construction material.

3.5.9 RECREATION

As per architectural principles, new buildings are usually sited to minimize the impact on available recreational fields. Although no mitigation is practically required, sufficient space shall be maintained for the existing recreational fields.

3.5.10 CULTURAL

Depending to the location of the project, if buried cultural or archaeological resources may be uncovered during construction activities, following mitigation measures shall be implemented to avoid any significant impact:

3.5.10.1 Mitigation 1

If potential cultural or archaeological resources are unearthed during construction, activities in that area shall immediately cease. The appropriate government office shall be contacted until such time as the government office provides authorization.

3.5.11 NOISE

Construction activities will result in noise impacts resulting from the use of heavy equipment and machinery. Noise levels will be typical for construction sites and no significantly loud equipment should be avoided if possible (i.e., pile drivers, crushers, etc.). Following mitigation measures shall be implemented to avoid significant impact:

3.5.11.1 Mitigation 1

The contractor shall as far as practicable, ensure that all processes, machines and equipment used implement one or more of the following measures:

- Engineering noise control, e.g., modifying noisy processes, machines and equipment, relocating noisy processes or isolating them within enclosures, erecting sound barriers, reducing kinetic or potential energy and regularly maintain machines and equipment.
- Using quiet machines and equipment when such machines and equipment are available in the market. Examples are generators, compressors and concrete breakers. The contractor shall provide hearing protectors for workers who are exposed to excessive noise and ensure that they are worn at all times. Warning signs to remind workers that hearing protectors must be worn shall be put at areas with excessive nose.

3.5.11.2 Mitigation 2

To the extent practicable, construction activities shall occur during normal working times. Where necessary to conduct operations in late evening or early morning, these operations shall be short in duration and shall be coordinated in advance with the project team and nearby inhabitants.

3.5.11.3 Mitigation 3

A community outreach program shall be implemented to ensure that local residents are aware of the purpose of the construction activities and have the opportunity to report any impacts.

3.5.12 SOLID, HAZARDOUS AND SPECIAL WASTES

Construction activities, including demolition and excavation, will result in solid wastes requiring disposal. There could also be evidence of hazardous or special wastes on the project sites that may result in contamination through spillage or unearthing.

Construction activities may result in the generation of hazardous wastes, including oils and lubricants. Accidental release of these wastes may result in impacts. To avoid such impact following mitigation measures shall be considered:

3.5.12.1 Mitigation 1

Solid wastes shall be transported off the site and disposed of in a disposal site previously approved by the relevant authority and/ or Ministry of Urban Development.

3.5.12.2 Mitigation 2

In the event buried hazardous wastes are uncovered during excavation, all construction activities shall cease.

3.5.13 GEOLOGIC AND SEISMIC HAZARDS

In areas considered as high seismic risk zones, infrastructure will be designed in accordance with approved seismic codes. Therefore, impacts related to geologic and seismic hazards are considered unlikely and no mitigation measure seems required.

3.5.14 UNEXPLODED ORDINANCE

Construction sites have mostly been surfacing survey and cleared of UXO in urban areas. However, heavy rains, frost heaves, or other factors in urban areas and at any case in rural areas can result in UXOs being uncovered. Disturbance or handling of UXOs can result in loss of life or limb.

To avoid significant impacts on this issue following mitigation measures shall be considered:

3.5.14.1 Mitigation 1

If a potential UXO is identified, the area shall be immediately vacated and secured. UNMACA or other qualified and authorized disposal organization shall be immediately notified and arrangements made to dispose of the potential UXO.

3.5.14.2 Mitigation 2

If excavation is required below the depth which has already been cleared, or if excavation is required outside the area that is not known as a clear zone, a certified demining organization shall be employed to survey and clear the area prior to any works.

3.5.14.3 Mitigation 3

UXO safety training shall be provided onsite to all workers. Training shall incorporate how to identify potential UXO and the appropriate response as described in 1.*5.14.1 Mitigation 1*.

3.6 DEMOLITION

3.6.1 GENERAL

3.6.1.1 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.

3.6.1.2 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.

3.6.2 PRODUCTS

3.6.2.1 Demolished Materials

Demolished Materials

Ownership: Ownership of demolished materials is described in the **Demolished Materials Classes table**.

Demolished Materials Classes Table

Class	**Ownership**
Salvaged for reuse	Principal/Proprietor
Salvaged for disposal	Principal/Proprietor
Demolished for re-use	Principal/Proprietor
Demolished for removal	Contractor

Reuse: If it is proposed to reuse demolished materials in the works, submit proposals.

Salvage: Recover without damage materials to be salvaged, for reuse in conformance with the **Salvaged Materials for Reuse Schedule** or for disposal in conformance with the **Salvaged Materials for Disposal Schedule**.

Removal: Remove from the site demolished materials which are the property of the contractor. Do not burn or bury on site.

Transit: Prevent spillage of demolishing materials in transit.

3.6.3 EXECUTION

3.6.3.1 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.

3.6.3.2 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.

3.6.3.3 Demolition

Explosives

Do not use explosives in the demolition process.

3.6.3.4 Hazardous Materials

General

General: Hazardous materials that have already been identified are set out in the **Identified Hazardous Materials Schedule**.

Hazardous Materials

General: Give notice immediately hazardous materials or conditions are found, including the following:

- Asbestos or material containing asbestos.
- Flammable or explosive liquids or gases.
- Toxic, infective or contaminated materials.
- Radiation or radioactive materials.
- Noxious or explosive chemicals.
- Tanks or other containers which have been used for storage of explosive, toxic, infective or contaminated substances.

3.6.3.5 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.

4 SITE

4.1 SITE PREPARATION

4.1.1 GENERAL

4.1.1.1 Aims

Responsibilities

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

4.1.1.2 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.

4.1.2 EXECUTION

4.1.2.1 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. Protect, by fencing if necessary, all trees or native growth from any damage caused by construction operations.

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.

4.1.2.2 Existing Services

Maintain existing utilities that are to remain in service. Before excavating over or adjacent to existing utilities, notify Engineer to ensure protective work will be coordinated and performed in accordance with requirements. If existing service lines, utilities and utility structures, which are to remain in service, are uncovered or encountered during these operations, safeguard and protect from damage. 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.

Within limits of excavation, remove existing piping, subsoil drainage systems, conduit, manholes and relocated items, which are to be abandoned. Plug open ends of utilities to remain with concrete.
Re-route existing subsoil drains which obstruct work around new construction or incorporate them into new drainage systems.

Existing Facilities: Protect and maintain in satisfactory manner, existing pavements, curbs, gutters, structures, conduits, fences, walls and other facilities to remain above and below grade. Restore facilities damaged by construction operations.

Pumping and Draining: Excavate areas in such manner as to afford adequate drainage. Control grading in vicinity of excavated areas so ground surface will slope to prevent water running into excavated areas. Until work is completed, remove water from areas of construction that may interfere with proper performance of work or that may result in damage to the soil sub-grade and provide sumps, pumps, well points, electric power and attendance required for this purpose on a 24-hour basis if necessary. Protect construction from water during construction, including prevention of erosion of completed work during construction and until permanent drainage and erosion controls are operational. Repair adjoining properties, facilities and streets damaged due to improper protection.
Do not excavate by machine within 1 m of existing underground services.

4.1.2.3 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.

4.1.2.4 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

A. The work includes clearing and grubbing areas within the boundary limits shown on the plans or staked by the Engineer. This work also includes protecting from harm all trees, bushes, shrubs or other objects selected to remain.

1. "Clearing" means removing and disposing of all unwanted material from the surface such as trees brush, down timber or other natural materials.
2. "Grubbing" means removing and disposing of al unwanted vegetative matter from the underground such as sod, stumps, roots, buried logs or other debris.
3. "Debris" means all non-usable natural material produced by 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, paving's, drains and manholes found on the surface unless identified on the drawings to remain intact.

4.1.2.5 Topsoil

Topsoil is the upper portion of a soil, usually dark coloured and rich in organic material.

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.

4.1.2.6 Disposal of materials

Remove cleared and grubbed material from the site.

4.2 BRICKWORK

4.2.1 GENERAL

4.2.1.1 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.

4.2.2 PRODUCTS

4.2.2.1 Materials

First Class Bricks

First Class Bricks shall be made from good brick earth free from saline deposits and shall be sand melded. They shall be thoroughly burnt by coal without being vitrified, of uniform and good colour, 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 First-Class Brick shall not absorb more than 1/6th of its weight of water after being soaked for one hour.

Second Class Bricks

Second Class Bricks shall be as well burnt as First Class or may be slightly over burnt but not vitrified and must give a clear ringing sound when struck one against another. Slight irregularities in size, shape or colour are acceptable provided irregular or uneven courses do not result. Second Class Bricks may have slight chips or flaws but must be free from lime or canker nodules. They shall not absorb more than 1/4th of their weight of water after being soaked for one hour.

General

Machine made pressed bricks shall be standard commercial products, locally manufactured unless specified. The Engineer prior to use in the Works shall approve the use of machine made pressed bricks.

Bricks not meeting the above requirements shall not be used in brickwork.

First and Second-Class Bricks should have these dimensions after burning: 220mm x 105mm x 65mm. Dimensions may vary according to manufacturer but must be approved by Engineer before laying. The unit weight of First and Second-Class Bricks shall not be less than 1100 kg/m^3.

The crushing strength of bricks shall be tested in a laboratory. The average crushing strength of First and Second-Class Bricks shall not be less than 10.3 MPa (105 kg/cm^2).

At the start of the works samples of the bricks shall be tested for crushing strength and water absorption, and 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 tested and approved.

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

Proportioning: 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.

4.2.2.2 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

Maximum span (mm)	**Wall height above ≤ 600 mm**			**Wall height above > 600 mm, ≤ 1800 mm**		
	Angle lintel size	**T-Lintel dimensions: H x W x T (mm)**	**Bearing min. (mm)**	**Angle lintel size**	**T-Lintel dimensions: H x W x T (mm)**	**Bearing min. (mm)**
1000	Two 75 x 50 x 5 Unequal angles	81 x 150 x 6	100	Two 125 x 75 x 8 Unequal angles	136 x 150 x 6	200
2000	Two 100 x 75 x 6 Unequal angles	136 x 150 x 6	150	Two 150 x 90 x 8 Unequal angles	156 x 150 x 6	200
2400	Two 125 x 75 x 8 Unequal angles	156 x 150 x 6	150	Two 150 x 90 x 10 Unequal angles	160 x 150 x 10	250
2800	Two 150 x 90 x 8 Unequal angles	158 x 150 x 8	200	Two 150 x 100 x 10 Unequal angles	210 x 200 x 10	300
3000	Two 150 x 90 x 10 Unequal angles	160 x 150 x 10	200	Two 150 x 100 x 12 Unequal angles	210 x 200 x 10	300

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

Maximum span (mm)	**Lintel height (mm)**
1200	150
1800	150
2400	200
3000	250

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.

4.2.3 EXECUTION

Refer to **Brickwork Construction** schedule for details of brickwork and mortar types.

4.2.3.1 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.

Brick should be laid as indicated in drawings or schedules, or as specified by Engineer. All horizontal joints shall be parallel and level. Vertical joints in alternate courses shall come directly over one another. Joint thickness shall be 8mm and shall in no case exceed 12mm. 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. Bricks should be laid so that only full courses are used to avoid splitting bricks at beams, ledges, lintels.

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 colour 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 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 B**rickwork 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.

Brickwork Chasing Table

Brick thickness (mm)	**Depth of chase (maximum mm)**
More than 250 thick	35
250 thick	25
100 thick non load bearing walls only	20

Joint Finish

Lay brickwork on a full bed of mortar. Fill perpendicular joints 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.

4.2.3.2 Face work

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.

Bricks or mortar shall not be stained or painted.

4.2.3.3 Damp-proof courses

Damp-proof Courses

Material: Embossed Polythene sheeting or bitumen membrane as approved by Engineer. 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.

4.2.3.4 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: 2.5m
- 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 **Brickwork Construction** and drawings for details of locations, types and extent of built in components.

4.3 WINDOWS AND WINDOW HARDWARE

4.3.1 GENERAL

4.3.1.1 Interpretation

Definitions

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

4.3.1.2 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.

4.3.2 PRODUCTS

4.3.2.1 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.

4.3.2.2 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.

4.3.2.3 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.

4.3.2.4 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.

4.3.3 EXECUTION

4.3.3.1 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 Weathering's

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 and **Window, Louvre and Security grille/shutter schedules** for details of windows. Refer to the **Window hardware schedule** for details of window hardware.

4.3.4 COMPLETION

4.3.4.1 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.

4.3.4.2 Adjustment

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

4.4 DOORS AND DOOR HARDWARE

4.4.1 GENERAL

4.4.1.1 Interpretation

Definitions

For the purposes of this work section the definitions given below apply.

Door frame: Includes door trims.

Dorset: An assembly comprising a door or doors and supporting frame, guides and tracks including the hardware and accessories necessary for operation.

Fire-door set: A door set which retains its strength and limits the spread of fire.

Smoke-door set: A door set 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.

Louvered door: A joinery door in which the panel spaces are filled in with louvre blades.

4.4.1.2 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.

4.4.1.3 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.

4.4.2 PRODUCTS

4.4.2.1 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 back plates inside the frame. Screw fix the hinges into the back plates.

Base metal thickness:

- General: ≥ 1.1 mm.
- Fire rated door sets: ≥ 1.4 mm.
- Security door sets: ≥ 1.6 mm.

4.4.2.2 Doors

Flush Doors

Cellular core flush doors:

- Provide a sub frame 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 and **Flush Doors** schedule for details.

Joinery Doors

Fabricate joinery doors as shown on the drawings and in the **Joinery Doors** schedule.

PVC Doors

Fabricate PVC doors as shown on the drawings and in the **PVC Doors** schedule.

Construction

Form rebates to suit standard rebated door hardware.

Louvre grilles: Construct by inserting the louvre blades into a louvre 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.

4.4.2.3 Door sets

Automatic Sliding Door Assemblies

Provide auto sliding door assemblies in accordance with the **Automatic door schedule**.

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 Doors eats

Provide fire resistant doors and frames as matched sets for door openings required to have a fire rating. Refer to the **Fire and smoke resistant doors eats schedule** for details.

Provide copies of test certificates from recognised authorities proving the performance of the door sets.

Smoke-Resistant Door sets

Provide smoke resistant doors and frames as matched sets for door openings required to have a smoke stopping capability. Refer to the **Fire and Smoke Resistant Door sets** schedule for details.

Provide copies of test certificates from recognised authorities proving the performance of the door sets or seals to frames.

Security Screen Door sets

Provide security screen door sets in accordance with the **Security Screen Doors schedule**.

4.4.2.4 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 Schedules and to approval of Engineer.

4.4.2.5 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

Nominal hinge size l x w x t (mm)	**Door leaves not exceeding any of the following**		
	Mass (kg)	**Width (mm)**	**Thickness (mm)**
70 x 50 x 1.6	16	620	30
85 x 60 x 1.6	20	820	35
100 x 75 x 1.6	30	920	40
100 x 75 x 2.5	50	920	50
100 x 75 x 3.2	70	1020	50
125 x 100 x 3.2	80	1220	50

Hinge Table B

Nominal hinge size l x w x t (mm)	**Door leaf not exceeding mass (kg)**	**Minimum construction**	
		Knuckles	**Screws/hinge leaf**
100 x 70 x 3	30	3	3
100 x 80 x 3.5	50	5	4

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.

4.4.2.6 Door Hanging Systems

General

Provide sliding door tracks in conformance with the **schedules**.

4.4.2.7 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.

4.4.3 EXECUTION

4.4.3.1 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 Weathering's

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.

Refer to the drawings and **Flush doors, Joinery doors, PVC doors, Security screen doors, Fire and smoke resistant door set** and **Automatic door schedules** for details of frames, doors and hardware.

4.4.4 COMPLETION

4.4.4.1 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.

4.4.4.2 Adjustment

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

4.5 SUSPENDED CEILINGS

4.5.1 GENERAL

4.5.1.1 Inspection

Notice

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

4.5.1.2 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.

4.5.2 PRODUCTS

4.5.2.1 Linings

Fibrous Plaster Tiles

All imported fibrous plaster tiles with hard cast plaster face for decorative ceiling sections.

Plasterboard Panels

All imported glass fibre reinforced gypsum plasterboard panels or tiles to approval of the Engineer. Refer to the **Suspended ceiling schedule**.

Suspension System

Refer to the **Suspended ceiling schedule**.

4.5.3 EXECUTION

4.5.3.1 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.

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.

4.5.3.2 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.

4.5.3.3 Access Panels

Finish

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

4.5.4 COMPLETION

4.5.4.1 Spares

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

4.6 TILING

4.6.1 GENERAL

Furnish all tools, equipment, materials, supplies, accessories and perform all labor to install ceramic tile work indicated on the Contract Drawings and as hereinafter specified.

4.6.1.1 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.

4.6.1.2 Submissions

Samples

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

4.6.1.3 Interpretations

Definitions

For the purposes of this work section 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.

4.6.1.4 Tolerances

Completed tiling

Conform to the **Tolerances table**.

Tolerances Table

Property	**Tolerance criteria**
Alignment: Deviation of the finished tiles from a 3 m straight edge laid against any joints	< 4 mm
Flatness: Deviation of any plane surface under a 3 m straight edge laid in any direction on an area of uniform grade	< 4 mm

4.6.2 PRODUCTS

4.6.2.1 Tiles and accessories

Provide tiles and accessories to the **Wall Tiling** and **Floor Tiling** schedules.

Coves, nosing's and skirtings: 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.

4.6.2.2 Adhesives

Type

General: Provide adhesives to the **Wall Tiling schedule** and to the **Floor Tiling schedule** and 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.

4.6.2.3 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.

4.6.2.4 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.

4.6.3 EXECUTION

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.

4.6.3.1 JOB CONDITIONS

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.

Protection

Protect adjacent surfaces against damage during progress of the work of this Section.

Coordination and Cooperation

Coordinate work of this Section with work of other trades. Perform work without delay to the work in progress.

Workmanship

In accordance with best practice; work performed by skilled workers; jointing's, intersections and returns well formed; drilling and cutting neatly done without marring the material; joints straight and solidly filled conforming to applicable "Standard Specifications" of the American National Standards Institute, Inc. ANSI A108.1 and ANSI A108.2.

4.6.3.2 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.

4.6.3.3 Preparation

Ambient temperature

Install mortar and set and grout the tile, only when the temperature is at least 10°C and rising.
If the ambient temperature is less than 10°C 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.

4.6.3.4 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.

4.6.3.5 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.

4.6.3.6 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.

4.6.3.7 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.

4.6.3.8 Movement joints

General

Provide movement joints to the **Tile Movement Joints schedule** and as follows:

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 m^2.

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.

4.6.3.9 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.

4.6.3.10 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.

4.6.3.11 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:

1. Remove mortar and grout prior to hardening during progress of work.
2. Clean surfaces thoroughly after grouting and pointing have set sufficiently; remove all cement, dust and other foreign matter with plain water or mild alkaline cleaner. Sandblasting of exposed surfaces is prohibited.
3. Cleaning with a solution not stronger than 10 percent muriatic acid to 90 percent water permitted only on unglazed tile; thoroughly wash afterwards with clean water. Completely protect hardware and fittings metal surfaces, cast iron and vitreous items from acid and fumes.
4. Cleaning shall be done in accordance with the manufacturer's recommendations.

4.7 PAINTING

4.7.1 GENERAL

4.7.1.1 Inspection

Notice

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

Materials and Equipment Not to be Painted

Unless scheduled, specified, or required by the drawings to be painted, the following items do not require painting. These surfaces shall be left completely clean and free from droppings and accidentally applied material.

1. Non-ferrous metals, chrome plated metal, and stainless steel.
2. Finish Hardware.
3. Ceramic tile.
4. Floor finish materials.
5. Acoustic tile.
6. Equipment furnished with complete factory-applied finish, (except A.C. units) unless specifically noted on the drawings or specified herein to be painted.

4.7.1.2 Submissions

Prior to start of painting, submit three copies of a complete list of all materials, identified by manufacturer's name and product label or stock number, to the Engineer for approval. This list shall be in the form of a repetition of the paint finishes specified, with the addition of the specific product intended for each coat.

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.

4.7.2 PRODUCTS

4.7.2.1 Materials General

Thinners, vehicles, pigments, and other incidental materials intended to be combined with or used with factory-mixed products shall be of the types and kinds recommended by the paint manufacturer for the intended purpose. Include listing of such materials in the material list required hereinafter.

Deliver materials to the job in unopened containers bearing manufacturer's name and product designation corresponding to designation on material list.

Insofar as practicable, each kind of coating for the various types of paint finish shall be factory-mixed to match approved samples and colors, and of consistencies ready for immediate application.

4.7.2.2 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.

4.7.2.3 Putty

Non-timber substrates: Oil-based or polymeric based.

Timber finishes: Lacquer or water based only.

4.7.3 EXECUTION

4.7.3.1 General

Store and mix paint materials in places as directed. Portions of the building used for paint storage and mixing shall be suitably safeguarded against stains, damage and defects. Take adequate precautions against fire hazard.

Mixing and thinning of prepared paints: In accordance with recommendations of manufacturer whose material is being altered, where necessary to produce satisfactory results.

Painting materials required for use on the project shall conform in all respects, with applicable air pollution control regulations.

4.7.3.2 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.

Acceptance of Surface

Inspect surfaces to be treated to effectively safeguard work of others and to preserve painted work free from damage of every nature.

All surfaces which are found to be unsuitable for application of paint finish, shall be properly prepared before painting is started. Application of the first coat of paint shall be construed as acceptance of the surface as satisfactory for application of painter's finish.

Report unsatisfactory conditions disclosed by inspections in writing for correction. Do not proceed with the work until such unsatisfactory conditions have been properly corrected.

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.

Under no circumstances is the painter allowed to get paint on any surface which is not to be painted. The painter is required to protect all surfaces other than the one which is to be painted immediately, with coverings. These include, but are not limited to: drop cloths, masking tape, plastic sheeting, and paper. No paint may be allowed on glass, stone, floors, stone walls, suspended ceilings, windows or any other surface which is not mean to be painted.

Cover well with drop cloths and do not use fixtures or finished building construction of any type for scaffolding or support of scaffolding.

Post signs immediately following application of paint. Exercise proper care to completely protect fixtures, and cabinets that will be installed before painting operations are complete.

In the event finish materials which require no painting should be accidentally splashed with paint or otherwise disfigured by unauthorized application of paint, and if the paint cannot be removed without damage to the material involved, then these materials shall be removed and replaced with new materials, and all costs incidental thereto shall be paid by the Contractor. Cleaning and removal of unauthorized paint or other such materials shall be accomplished with materials and procedures which are non-injurious to the surface, all as approved by the Architect.

After completion and acceptance of the painter's work in any area, the Contractor shall be responsible for provision and maintenance of such forms of protection that may be required to protect finished work from damage from any cause prior to acceptance of the job by the Owner. Schedule the work, and exclude traffic and unauthorized personnel from finished areas, to the extent necessary to prevent damage.

"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 discolouration's, including staining by oil, grease and nailheads.

Puttying.

4.7.3.3 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.

Number of Coats

The number of coats specified is minimum that shall be applied. It is intended that paint finishes of even, uniform color, free from cloudy or mottled surfaces, be provided. The work shall be "spot-coated" or undercoated as necessary. Unless specified as one coat or two coat systems, each paint system consists of at least 3 coats comprising priming coat and 2 top coats.

Each coat shall be of a proper ground color to receive a succeeding coat, and wherever practicable, shall differ in color tint. Each coat shall be approved by the Architect before the next coat is applied; otherwise an extra coat will be required over the entire surface involved, except where otherwise directed.

Drying

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

Paint application

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

Priming before fixing

Apply one coat of wood primer (2 coats to end grain) to the back of the following before fixing in position:

- Timber door and window frames.
- Bottoms of external doors.
- Associated trims and glazing beads.

Spraying

If the paint application is by spraying, use conventional or airless equipment which does the following:

- Satisfactorily atomises the paint being applied.
- Does not require the paint to be thinned beyond the maximum amount recommended by the manufacturer.

- Does not introduce oil, water or other contaminants into the applied paint.

Sanding

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

Repair of Galvanizing

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

4.7.4 SELECTIONS

4.7.4.1 Paint Systems

Paint System Description

Choose from the following paint systems and substrates and paint in accordance with manufacturers recommendations and **Interior** and **Exterior Painting** schedules.

Paint Systems

Flat water based: Interior
Low gloss water based: Interior
Flat or low gloss water based: Exterior
Semi-gloss water based: Interior
Semi-gloss water based: Exterior
Gloss water based: Interior
Gloss water based: Exterior
Semi-gloss, oil based: Interior
Full gloss, oil based: Interior
Full gloss, oil based: Exterior
Texture finish, water based: Interior
Texture finish, water based: Exterior
Varnish clear: Interior
Varnish clear: Exterior
Varnish tinted: Interior
Opaque timber finish, water based: Exterior
Clear or tinted timber finish, oil based: Interior
Clear or tinted timber finish, oil 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
Stonework
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

Colour Selection
As nominated in the **Interior** and **Exterior painting** schedules.

5

5.1 WATER SERVICES

5.1.1 GENERAL

5.1.1.1 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.
- This is typical text. Edit to suit the project.
- Hot water services: Provide the hot water installation from the cold-water connection points to the draw-off points or connections to other services.
- This is typical text. Edit to suit the project.
- Hose reel system: Provide the hose reel system where defined on the drawings and in the BOQ.
- Describe the required system. Delete if not applicable.
- Sanitary plumbing and drainage: Provide the plumbing and drainage system where defined on the drawings and in the BOQ.
- Describe the required system.
- Stormwater: Provide the stormwater system where defined on the drawings and in the BOQ.
- Describe the required system.
- Subsoil drainage: Provide the subsoil drainage system where defined on the drawings and in the BOQ.

5.1.1.2 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.

5.1.1.3 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.

Samples

Provide samples listed in the **Water Services Samples schedule**.

5.2 EXECUTION

Refer to the **Water system piping** schedule for details of all pipe types.

5.2.1.1 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 metals, with bonded PVC or glass fibre woven tape sleeves where needed 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.

5.2.1.2 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.

5.2.1.3 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.

Finishes

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.

5.2.1.4 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 **Sanitary fixtures schedule**.

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. Refer to the **Sanitary fixtures schedule**.

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.

5.2.1.5 Water Heaters

Standard Electric Systems

Provide standard electrical water boilers as identified in the BOQ to locations identified on the drawings. Refer to the **Water heater** schedule.

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.

5.2.1.6 Hose Reels

General

Provide hose reels with swivel hose guides in accordance with the **Fire hose reels schedule**.

5.2.1.7 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.

5.2.1.8 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 $\geq$ 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.

5.2.1.9 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 in the **Sanitary fixtures schedule** complete with all accessories necessary for correct installation and use.

5.2.1.10 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 expansion.

5.3 HOT WATER HEATING SERVICES

5.3.1 GENERAL

Responsibilities

Provide services systems subject to the site and following constraint:

- Hot water services: Provide the hot water installation from the existing hot water heating system main network draw-off points or connections to other services.

5.3.1.1 Inspection

Notice

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

- Underground pipework prior to concealment.
- Above ground pipework and fixture installation prior to concealment.

5.3.1.2 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.

Samples

Provide samples listed in the **Hot water heating Services Samples schedule**.

5.3.2 PRODUCTS AND EXECUTION

Refer to the **Hot water heating system piping** schedule for details of all pipe types.

5.3.2.1 Installation generally

Accessories

Provide the accessories and fittings necessary for the proper functioning of the systems, including 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.

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 75 mm clearance between adjacent pipelines (measured from the piping insulation where applicable).

Pipe support materials: To be the same as the piping or galvanized or non-ferrous metals, with bonded PVC or glass fibre woven tape sleeves where needed to separate dissimilar metals.

Technical service room

See drawing for location, architectural dimensions and structural specs of the technical room.

5.3.2.2 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.

5.3.2.3 Execution generally

In order to execute best hot water central heating system, the contractor shall consider following general points:

1. All the pipes used in the system shall be steel pipes and shall be integral-cast pipes with no sign of joint-lines along the pipe surface.
2. Connection method for all pipes shall be either electrical or gas welding method.
3. Pipes with diameter of up to 20mm shall be bended directly in the turns and corners and shall not be fitted using elbows or other fittings.
4. Pipes having 25mm to 100mm diameter shall be redirected in turns and corners using steel elbows welded in connection points, no screwing method is allowed.
5. Valves used in hot water heating system shall be of purposely designed valves to be fitted using screwing methods with the system. Valves with diameter 32mm or more shall be of flanged type valves only.
6. Main supply pipes (with diameters of 32mm to 100mm) shall be properly heat insulated using mineral wool insulation sheets having an R-value of not less than 5.
7. The heating system shall have 2 separate water filters one installed at the incoming point where the liquid comes from the boiling center and another installed at the end of the system where the water circulates back toward the

boiling system. This is required to filter any dusty granulations, stains etc arise either at the boiling center or at the radiators.

8. The system shall be equipped by a manometer to show the system pressure for all the time.
9. The heating system shall be equipped by 2 separate thermometers: one installed to show the incoming liquid temperature (could be up to 120 ºC) and another to display the outgoing liquid temperature. These helps monitoring staff to identify many of the system problems.
10. There are different types and standard sizes of plates and radiators that can be used in different building types as per given drawings:
    - Plate sizes of: 500X160mm, 600X150mm, 900X150mm, 1200X150mm and 1200X300mm.
    - Plate types: Cast iron, Steel, Aluminum.

    Cast-iron type: This type has a very good quality and takes longer to get hot and takes longer to lose its potential temperature.

    Steel type: This type is good but exposed to rust/corrosion. This type, however, gets hot and cool quickly.

    Aluminum type: This type is safe against rust/corrosion and can get hot and cool quickly too.
11. The hot water heating system shall be equipped with air venting valves. These valves are vital to make sure no air exist within the system during installation and during first time circulation of the liquid into the system.
12. Proper supports and clips are to be used to mount the radiators on the walls firmly and safely. The supports shall prevent all radiator movement; horizontally, vertically; and prevent them from being tilted and turning and falling.
13. Leakage test shall be applied on overall heating system using special machinery establishing at least (4 to 5 bar pressures for pipes up to 25mm and 4 to 8 bar pressures for pipes with diameter of 32 to 100mm) at least 24 hours continuous testing period.
14. Painting: surfaces for all steel pipes and other members shall be neat and free of any dust or materials (use proper sand papers if required). After the substrate is ready for painting; one coat of anti-rust paint following with two other coats of oil-based painting to be applied. In case the Cast-Iron radiator used in the system, the radiators shall also be painted with one coat of anti-rust following two coats of oil-based painting.

6 ELECTRICAL

6.1 ELECTRICAL SERVICES

6.1.1 GENERAL

6.1.1.1 AIMS

Responsibilities

Provide electrical systems in conformance with the **Electrical Systems Schedule**.

Qualification

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

Performance

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

Rates for installation work

Rates for installation of cabling, light fittings, sockets, switches and all other electrical components are to include allowance for fixings, connection, chasing of wiring and any other works required for the installation of the electrical system to a fully operational and safe working condition.

6.1.1.2 Inspection

Notice

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

- Underground electrical services conduits prior to concealment.
- Above ground electrical services conduits in walls prior to concealment.
- Switchboards prior to installation.

Inspection and testing on completion

To verify that the requirements of this specification have been met, all electrical installations and any alterations, additions or repairs to an existing electrical installation, after completion and before being energised shall be:

- Inspected as far as is practicable
- Tested

Precautions shall be taken to insure the safety of persons and to avoid damage to property and the electrical installation equipment during inspection and testing.

NOTE: if requires, the contractor is responsible to provide temporary power generator in order to undertake all needed testing.

A visual inspection shall be made when work on an electrical installation has been completed in order to verify that the work complies with the requirements of this specification. The visual inspection shall be carried out before, or in association with testing and shall where practicable be made before the relevant part of the electrical installation is placed in service. Visual inspections shall be carried out prior to the completion of the installation where that part of the electrical installation will be covered by following works.

The following items provide a guide to the matters to be checked during the visual inspection to assess that the relevant requirements of this specification have been met.

General:

- Protection against direct contact with live parts e.g. Insulation and enclosure.
- Protection against indirect contact with exposed conductive parts, e.g. Double insulation or isolating transformers.
- Protection against hazardous part, e.g. Enclosure, guarding or screening of flammable materials, hot surfaces and parts that may cause physical injury.
- Protection against spread of fire, e.g. Penetration of fire barriers.
- General condition of the electrical equipment, e.g. Signs of damage that could impair safe operation, disconnection of unused electrical equipment.

Consumers Mains:

- Current carrying capacity.
- Voltage drops.
- Underground installation conditions, e.g. Enclosure, depth of burial and mechanical protection.
- Aerial installation conditions.
- Connection of wiring.
- Protection against external influences.

Switchboards:

- Location, e.g. Access and egress.
- Protective devices, e.g. Overload and residual current rating, fault current rating.
- Isolating devices, e.g. Main switches.
- Connecting devices, e.g. Neutral bars, earth bars and live links.
- Connection and fixing of wiring and switchgear.
- Identification and labelling of electrical equipment.
- Protection against external influences.

Wiring systems:

- Conductor size, e.g. Current-carrying capacity and voltage drop.
- Identification of cable cores.
- Adequate support and fixing.
- Connections and enclosures.
- Particular installation conditions, e.g. Underground, aerial and emergency systems.
- Segregation from other services and electrical installations.
- Protection against external influences, e.g. Enclosure.

Electrical equipment:

- Isolation and switching devices for protection against injury from mechanical movement devices and motors.
- Isolation and switching devices for protection against thermal effects, e.g. Motors, room heaters and water heaters.
- Switching devices for particular electrical equipment, e.g. Socket outlets and cooking appliances.
- Particular installation conditions, e.g. Locations affected by water, explosive atmospheres, extra low voltage and high voltage.
- Compliance with required standard.
- Connection, support and fixing.
- Protection against external influences.

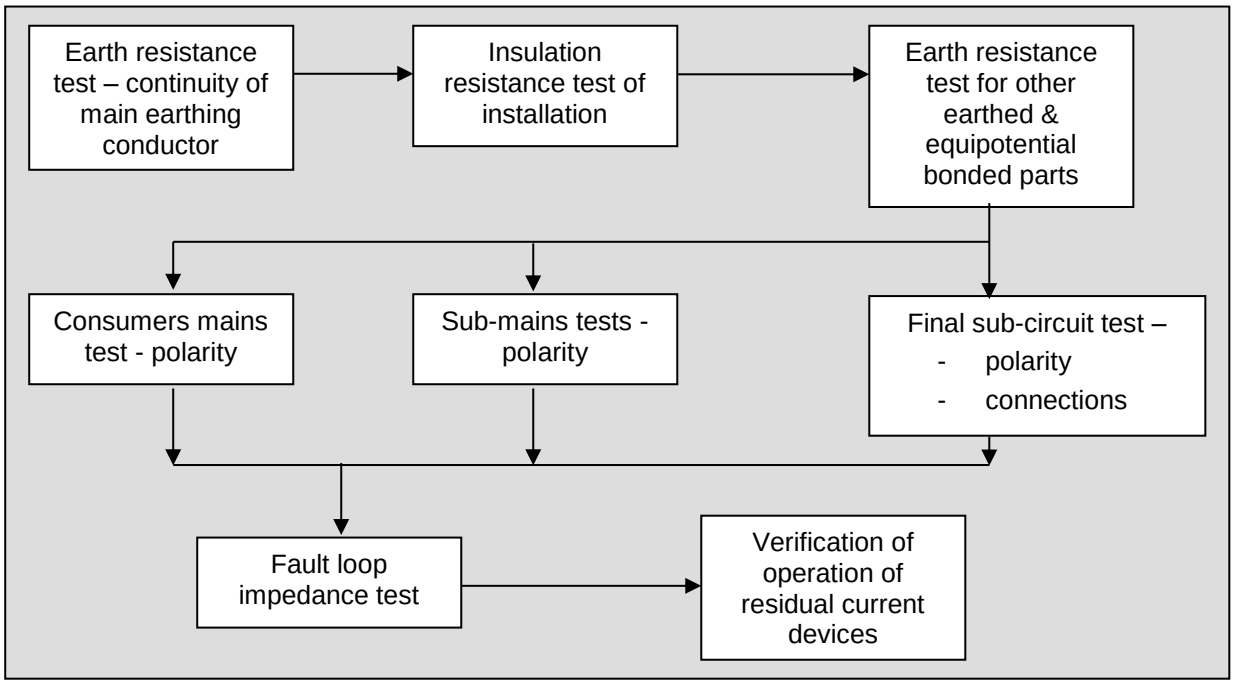
Earthing:

- Multiple earth neutral (MEN) connection.
- Earth electrode.
- Earthing conductors, e.g. Size and identification.
- Equipotential bonding conductors, e.g. Size and identification.
- Connections, joints and terminations.
- Protection against external influences.
- Connection to earthing arrangements for tother systems.
- Creation of earthed situation that may require earthing of additional electrical equipment.

Testing:

After completion of, or in association with the visual inspection tests, testing shall be carried out on the electrical installation to verify that it complies with their requirements of this specification and that it is suitable for the use intended.

Sequence of tests as noted:



6.1.2 EXECUTION

6.1.2.1 GENERAL

General

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

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

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

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

Samples

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

Installation of accessories

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

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

Mounting heights: To on-site direction

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

Surface mounting: Proprietary mounting blocks.

6.1.2.2 Installation of Accessories Table

Wall construction	**Installation and concealed cabling facilities**
Rendered brickwork partition	Flush wall box with conduit chased into wall
Double sided face brick partition	Vertically mounted flush wall box with conduit concealed in cut bricks
Concrete wall or slab	Flush wall box or flush mounted outlet with thermoplastic insulated cables in conduit integral with slab. Do not chase into concrete walls without obtaining approval from the Engineer.

Installation of ceiling mounted appliances

Connections: Provide flush mounted outlets on the ceiling next to support brackets.

Fixing: Provide support brackets fixed through ceiling to the building structure. Brace appliances that have excessive bending moments, are heavy or vibrate, to prevent horizontal movement.

Electrical installations

- All cabling and wiring is to be installed in approved PVC conduit or within a metal cable tray for horizontal runs within the ceiling. there will be no exceptions. Any cabling installed otherwise will be removed and replaced correctly at the contractor's expense. All below ceiling level electrical circuits are to be installed in surface mounted conduits.
- International standard connectors (chocolate block) for the wiring and cabling are to be used for all connections, no other method is acceptable.
- All IP ratings given refer to Ingress Protection (IP) Codes to AS1939.

NOTE: Simple twisting of wires as a means of connecting wires and cables with protective electrical tape is not acceptable.

Earthing/Grounding

- All installed electrical fixtures and fittings are to be earthed to the main earth system for the facility, there are no exceptions to this requirement.
- All protective earthing conductors should be incorporated in the same wiring enclosure as the associated live conductors or in the adjacent vicinity.
- Where a 'clean' earth is specified for a particular item of electrical equipment, the manufacturer of the electrical equipment shall be consulted in order to confirm the necessary arrangements.
- Precautions shall be taken against the risk of damage to the earthing arrangement and other metallic part of the electrical installation through electrolysis or galvanic action.
- The size of an earthing conductor shall be such that it meets the requirements of the IEC regulations and is in accordance with the Earth conductor size table.

Earth Conductor Size Table

Nominal size of live conductor (mm^2)	Nominal size of copper earthing conductor (mm^2)	
	With copper live conductors	**With aluminium live conductors**
1	1*	-
1.5	1.5*	-
2.5	2.5	-
4	2.5	-
6	2.5	2.5
10	4	2.5
16	6	4
25	6	6
35	10	6
50	16	10
70	25	10
95	25	16
120	35	25
150	50	25
185	70	35
240	95	50
300	120	70
400	120	95
500	120	95
630	120	120

* These earthing conductors may be used only where incorporated in a multicore cable or flexible cord.

6.1.2.3LOW VOLTAGE POWER SYSTEMS

General

Provide a complete operational low voltage power system, comprising the following and to the Electrical supply mains **and** Electrical switchboard design schedules:

- Supply from mains power
- Metering.
- Consumers mains and switchboard.
- Submains and sub boards.
- Final sub circuits.

Submissions

Technical data: Submit documentation to fully describe the proposed installation. As a minimum provide:

- Submain cable routes and support or enclosure method.
- Switchboard cupboard layouts including risers.

Accessories

Provide the following and to the Power accessories **and** Lighting control and fittings schedules:

- General power outlets.
- Isolating switches.
- Three phase outlets.

- Ceiling mounted sweep fans
- Duct heaters
- Wall, window or roof mounted exhaust fans
- Light switches
- Light fittings
- Emergency lighting and exit signs
- Other equipment as identified in the Schedule

Junction and terminal boxes

Shall be manufactured from PVC and rated to IP56. They shall come complete with a rigid PVC cover attached by means of screws.

Switches

All switches are to be manufactured in compliance with international standards IP24. rate is to include allowance for installation of switches recessed into the wall. Switches are to be installed in locations as shown on the drawings.

Wiring systems

Selection: Provide wiring systems appropriate to the installation conditions and the function of the load. All wiring quality to be approved by the Engineer before installation commences.

Power cables

Copper cable generally, multi-stranded except for MIMS. All cabling is to be manufactured to international standard (BS 5467 or BS 6500) and meet all appropriate safety and performance requirements.

Minimum size:

- Lighting sub circuits: 1.5 mm^2.
- Power sub circuits: 2.5 mm^2.
- Submains: 6 mm^2.

Voltage drop: Install final sub circuit cables within the voltage drop parameters dictated by the route length and load.

Dummy load tests

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

6.1.2.4 SWITCHBOARDS

General

Provide proprietary switchboards to the following and to the Electrical switchboard design schedule:

- Main switchboard.
- Distribution boards.

Distribution boards shall be constructed from steel with a lockable door. Boards shall be sealed to meet a rating of IP56. All cable entry and exit points shall be constructed using suitable sized, proprietary PVC cable glands.

Statutory authority's equipment

Refer to local supply authority service rules to determine their requirements. Install equipment supplied by the statutory authority and provide wiring to complete the installation.

Cable entries

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

Construction

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

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

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

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

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

6.1.2.5 SWITCHBOARD COMPONENTS

Switch-isolator and combination fuse-switch units

Rated current: To suit unit installed in enclosure.

Rated fault capacity: Provide units selected for short-circuit making capacity that is at least the fault level at assembly incoming terminals.

Breaking capacity: At least the rated full load current.

Rated duty: Uninterrupted in non-ventilated enclosure.

Operation: Independent manual operation including positive *'ON/OFF*' indicator.

Locking: Provide for padlocking in the *'OFF*' position.

Handles: Removable only when switch is in open position.

Fuse links: Isolated when switch contacts are open.

Moulded case and miniature circuit breakers

Moulded case breakers to International Standards.

Miniature circuit breakers to International Standards

Fault capacity > 10 kA circuit breakers to approval of Engineer

Fault capacity < 10 kA, current rating < 100 A: Miniature overcurrent circuit breakers

Mounting: Mount circuit breakers so that the '*ON/OFF*' and current rating indications are clearly visible with covers or escutcheons in position. Align operating toggles of each circuit breaker in the same plane.

Clip tray chassis: For miniature overcurrent circuit breakers provide clip tray assemblies capable of accepting single, double, or triple circuit breakers, and related busbars. Provide moulded clip-on pole fillers for unused portions.

Residual current devices

Integral type: Incorporate earth leakage in circuit breaker protection operation.

Maximum tripping current: 30 mA.

Fuses with enclosed fuse links

Standards: To International Standards

Fault level: Provide fuses suitable for the fault level at the assembly, and which discriminate with other protective equipment.

Let-through energy and peak cut-off current: To suit protected equipment.

Fuse-holders: Mount fuse-holders so that fuse carriers may be withdrawn directly towards the operator and away from live parts. Provide fixed insulation which shrouds live metal when the fuse carrier is withdrawn.

Barriers: Provide barriers on both sides of each fuse link, preventing inadvertent electrical contact between phases by the insertion of screwdriver.

Fuse links: Enclosed, high rupturing capacity type mounted in a fuse carrier. If necessary for safe removal and insertion of the fuse carrier, provide extraction handles. Mount on clips within the spares cabinet.

Identification: Clearly indicate manufacturer or distributor.

Contactors

Standard: To International Standards.

Rated operational current: Full load current of the load controlled.

Minimum rating: 16 A.

Mounting: Mount with sufficient clearance to allow full access for maintenance, removal and replacement of coils and contacts, without the need to disconnect wiring or remove other equipment.

Interconnection: Do not connect contactors in series or parallel to achieve ratings.

6.1.2.6 LIGHTING

General

Provide a complete operational lighting system, tested and commissioned.

Proprietary equipment: Provide only proprietary lights, fittings and accessories.

Modifications and refurbishing: Carry out to the original manufacturer's standards.

Lamps

Lamps: Provide all lights complete with lamps and accessories.

Verify operation: Install lamps in all lights and verify correct operation before completion

Low voltage lamps: Provide lamps strictly in accordance with the light manufacturer's recommendation.

Dichroic lamps: Provide dichroic lamps with integral reflector which match the design specification.

Lighting Control System

Provide the following and to the Schedules:

- Lighting switches.
- Dimmers.
- Automatic control systems.
- External light fittings.
- Internal light fittings.

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

Installation

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

Completion

Verify the operation of all lights.

6.1.2.7 EMERGENCY EVACUATION LIGHTING

General

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

Single-point system lights

Visual indicator lights: Provide a red indicator, readily visible when the light is in its operating location, which indicates that the battery is being charged.

Inverter system: Provide protection of the inverter system against damage in the event of failure, removal or replacement of the lamp, while in normal operation.

Local test switches: Provide a momentary action test switch, accessible from below the ceiling, on each fitting to temporarily disconnect the mains supply and connect the battery to the lamp.

Common test switches: Provide a common test switch on the distribution board which disconnects main supply to the lights and tests for discharge performance, after testing, this switch must automatically revert to normal operating mode.

Batteries

Type: Lead-acid or nickel-cadmium batteries capable of operating each lamp at its rated output continuously at least 2 hours during completion tests and 1.5 hours during subsequent tests.

Battery life: At least 3 years when operating under normal conditions at an ambient temperature of 25ºC and subjected to charging and discharging at 6 monthly intervals.

Marking: Indelibly mark each battery with its date of manufacture.

Power supply to single-point systems

Provide an unstitched active supply to each fitting and exit sign, originating from the test switch control panel.

6.1.2.8 TELECOMMUNICATION CABLING

General

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

Include the following and to the Telecommunication equipment schedule:

- Building distributor.
- Backbone cabling.
- Floor distributors.
- Consolidation points.
- Equipment racks and patch cords.
- Horizontal cabling.
- Telecommunications outlets.
- Fly leads.

Equipment racks

Type: 19-inch rack.

Free standing racks: Provide adjustable feet.

Modular connector patch panels

Terminations: Terminate directly to the modular connector.

Patch cords: Terminate cord ends with appropriate registered jacks.

Optical fibre termination panels

Break out trays: Provide fibre optic cable break out trays at each group of fibre optic cable terminations.

Loom cables: Neatly loom cables and lay stripped cables into the break out tray.

Secure cables: Ensure that cables are secured by the sheath and that there is no stress on the fibre optic cores.

Patch cords

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

Records

Record book: Provide a record book at each cross connect.

Records in pencil: Complete the records in pencil for each termination and jumper, providing origin and destination and type of service.

Location: Secure log books in each distribution frame records holder.

Cable separation

Low voltage cables: Separate telecommunications cables not enclosed in conduits or ducts from low voltage services by at least 150 mm.

Electromagnetic interference (EMI): Provide clearance to minimise the effect of EMI where communications cables are installed parallel and adjacent to power cables carrying loads in excess of 200 A.

Installation

Crossover: Install cables neatly and without crossovers between cables.

Loom size: Loom cables into groups not exceeding 50 cables and hold looms in place using reusable cable ties at least 20 mm wide. Do not exert compressive force on the cables when installing cable straps.

Telecommunications outlets

Outlets: Provide RJ45 8-way modular jacks except where documented otherwise.

Pinouts: The pinouts vary with the application. Determine required pinouts before making cable terminations.

Fly leads

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

Earthing system

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

6.1.2.9 AUTOMATIC FIRE DETECTION

General

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

Base station monitoring system connection

Connection: Connect the installation to the fire alarm monitoring base station via telecommunication carrier lines where identified in the **Fire detection equipment schedule**.

Installation wiring

Conductor size: > 1.5 mm^2 TPI 220 V rated, with red and white insulation.

Sheathing: Red.

Fire indicator panels

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

Detectors

Provide the following detector types as indicated on the drawings:

-Point type heat detectors.

-Duct sampling units.

-Integral heat detector/alarm units.

-Point type smoke detectors.

-Integral smoke detector/alarm units.

Self-indicating detectors

Provide a light emitting diode mounted in a clearly visible position, which illuminates whenever detector operation causes an alarm condition to register on the fire indicator panel. Provide self-indicating devices which, if faulty, will not render the detector inoperative under fire conditions.

Mounting positions of light emitting diodes:

- Visible detectors: On the outside of the detector or its base.
- Detectors concealed above ceilings: On the underside of the ceiling immediately below the detector.
- Detectors in other concealed spaces: On a visible panel close to the entry to the concealed space housing the detector.

Installation

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

Control facilities

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

Fire fan control and indication panels

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

6.1.2.10 ACCESS CONTROL

General

Provide a complete operational access control system, tested and commissioned in accordance with International Standards as applicable. Refer to the **Access control equipment schedule**.

Processors or panels

Capacity: Provide separate entry/exit control modules for each designated door.

Users: Program the system to match the number of authorised users with unique access codes.

Time zones: At least 3 per day, with provision for weekends and public holidays.

Door control devices

Provide electric strikes, electric locks, drop bolts, or similar devices to suit door construction and hardware.

Fail-safe: Connect door control devices in a fail-safe mode to permit exit in the event of power failure.

Authorised products: Provide equipment approved for use by the Engineer.

Double leaf doors (solid frame): Provide an electric strike or lock on the fixed leaf, connected to the door frame by concealed flexible wiring.

Activation

Provide keypads, card readers or other activation devices, and locate next to entry points.

External: Provide weatherproof (IP56) hoods or housings for external units.

Mounting height: 1200 mm from floor level.

Vehicle control

Vehicle access control: Provide a vehicle access control system combining connection to vehicular doors and boom gates, and interconnection to the main access control system.

Exit Loop detection: Provide a buried loop detection system adjacent to the exit point to activate boom gates or vehicular doors on approach by a vehicle. Connect so that doors or gates close after a pre-set time.

Interlock: Provide a photo electric beam safety interlock.

Interlock function: To prevent door or gate from closing until the vehicle has cleared the exit point.

Push-buttons and readers: Where practicable, provide direct wall mounting for push-buttons or readers; otherwise provide a mounting bollard and extension arm.

Mounting height: 1000 mm from floor level.

Reed switches: Provide heavy duty reed switches on both sides of vehicle doors, which generate a door closed indication at the control panel.

Intercom

Base station: Provide an intercom base station at each external entry point, interconnected with the individual local stations. Include speakers and microphones.

Construction: Wall mounted flush stainless-steel panel.

Weatherproofing: IP56.

Dial: Digital push-button type.

Schedule: Provide a weatherproof (IP56) schedule holder and card identifying individual local stations. Locate next to the intercom panel.

Local station: Provide wall mounted intercom local stations, interconnected with the base stations and external entry points.

Type: Surface mounted, removable handset type.

Operation: Provide an audible tone device to indicate that the individual station is being called, and a press-to-talk switch so that the local station can communicate with the base station only when the switch is held down.

Door control: Provide integral momentary action door release switches to operate the door release or opening mechanisms at each external entry point.

6.1.2.11 LABELLING

General

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

Identifying labels

Provide labels fixed to access panels, doors, covers and escutcheon panels and internal equipment, indicating the relevant information and componentry.

Single-line diagrams

Custom-built assemblies: Provide single-line diagrams.

Format: Non-fading print, at least A3 size, showing the situation as installed.

Mounting: Enclose in a folder and fix close to assembly.

Marking cables

Identify the origin of all wiring by means of legible indelible marking.

Identification labels: Provide durable labels fitted to each core and sheath, permanently marked with numbers, letters or both to suit the connection diagrams.

Telecommunications Cabling

Label telecommunications cables. cross connects and outlets.

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

Location marking

Accurately mark the location of underground cables with route markers consisting of a marker plate set flush in a concrete base.

Location: Place markers at each joint, route junction, change of direction, termination and building entry point and in straight runs at intervals of not more than 100 m.

Concrete bases: 200 mm diameter x 200 mm deep, minimum.

Direction marking: Show the direction of the cable run by means of direction arrows on the marker plate. Indicate distance to the next marker.

Plates: Brass, minimum size 75 x 75 x 1 mm thick.

Plate fixing: Waterproof adhesive and 4 brass or stainless steel countersunk screws.

Marker height: Set the marker plate flush with paved surfaces, and 25 mm above other surfaces.

Labelling – Minimum Lettering Heights

Main assembly designation: 25 mm.

Distribution assembly designations: 15 mm.

Small proprietary distribution boards: 10 mm.

Main switches: 10 mm.

Outgoing functional units: 8 mm.

Identifying labels (on outside of cabinet rear covers): 4 mm.

Danger, warning and caution notices: 10 mm for main heading, 5 mm for remainder.

Other labels including equipment labels within cabinets: 3 mm.

Label colours

Generally black lettering on white background except as follows:

- Main switch and caution labels: Red lettering on white background.
- Danger, warning labels: White lettering on red background.

Fixing

General: Fix labels securely.

Fixing methods: Use screws and double-sided adhesive. Fixed in extruded aluminium sections attached to panels with rivets or countersunk screws.

Permanent fixing: Fix labels permanently in place.

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