APPENDIX 1
GENERAL SAFETY, HEALTH AND ENVIRONMENTAL REGULATIONS

Appendix 1

General Safety, Health and Environmental Regulations

1 Introduction

1.1 The prevention of injury and/or illness to site personnel and the public, damage to the Works and to public and private property, protection of the environment, and compliance with applicable laws, are primary objectives of the Employer, and because of the importance the Employer places on meeting these objectives, selected minimum requirements are outlined in these Safety, Health and Environmental Regulations with which Contractors shall comply while working on Government contracts. Given that these Regulations cannot cover every eventuality, the Contractor shall be expected to exercise good judgment in all such matters, even though not mentioned in these Regulations, and shall take any and all additional measures, as required or necessary, to meet his responsibility for safety, health and environmental matters during the period of the Contract.

The Employer and its representatives shall not be held liable for any actions taken by the Contractor that are attributed to following the minimum requirements stated hereinafter.

1.2 The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein:

(a) have full regard for the safety of all persons on the Site and keep the Site and the Works in an orderly state appropriate to the avoidance of danger to any person;

(b) know and understand all laws governing his activities along with any site requirements and work site hazards. Such information shall be communicated by the Contractor to his personnel and subcontractors;

(c) take all necessary measures to protect his personnel, the Employer's personnel, other persons, the general public and the environment;

(d) avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of carrying out the Works.

2 Compliance with Regulations

2.1 The Contractor shall comply with the requirements of these Safety, Health and Environmental Regulations and all other applicable regulations or requirements under Lebanese laws, laid down by relevant authorities or issued by the Employer or the

Engineer concerning safety, health and the environment, in force or introduced or issued from time to time during the period of the Contract.
In so far as these Regulations are applicable, they shall apply to sites and personnel outside the Site associated with the performance of the Contract.

2.2 The Regulations equally apply to subcontractors and all other parties engaged by the Contractor and their personnel. The Contractor shall ensure all such parties are fully aware of and comply with the Regulations.

2.3 The Contractor shall comply with all notifications and written or verbal instruction regarding safety issued pursuant to these Regulations by the Employer, Engineer or relevant authorities within the time specified in the notification or instruction.

Whenever the Contractor is required to obtain the approval, agreement, permission, etc of the Engineer, such approval, agreement, permission, etc shall not relieve the Contractor of his responsibilities and obligations under these Regulations or the Contract.

2.4 The Contractor shall adopt a positive approach, awareness and responsibility towards safety, health and the environment, and take appropriate action, by:

(a) ensuring the Regulations are enforced and followed by the Contractor's personnel. Any failure by the Contractor's personnel to follow the Regulations, shall be regarded as a failure by the Contractor.

(b) paying attention to possible injury to unauthorised persons entering the site, particularly children.

2.5 Whenever in these Regulations the Contractor is required to provide test certificates for equipment and personnel or to comply the relevant authorities' requirements and no independent test facilities are available or no relevant authorities exist in Lebanon, the Contractor shall provide:

a) in lieu of independent test certificates:

- for equipment - details of the tests and the date of the tests that have been carried out by the Contractor and a written statement that the Contractor has satisfied himself that the item of equipment is fit and safe for use;

- for personnel - details of the training and experience and a written statement that the Contractor has satisfied himself that the person has the required level of competency;

b) in lieu of relevant authorities' requirements - details of the Contractor's own rules, regulations, requirements and procedures regarding safety, health and the environment.

If the Engineer is dissatisfied with the details provided by the Contractor, the Contractor shall provide further details or carry out further tests or provide further written statements as may be reasonably required by the Engineer.

When the Engineer has satified himself regarding the Contractor's own rules, regulations, requirements and procedures provided in accordance with (b) above, such rules, etc shall be deemed to form part of these Regulations and to which Clause 3 shall equally apply.

3 Failure to Comply with Regulations

3.1 General

3.1.1 Should the Contractor fail to comply with any of the Regulations or requirements:

(a) the Engineer may suspend the Works or part of the Works until the Contractor has taken necessary steps, to the satisfaction of the Engineer, to comply with the regulations or requirements.

(b) the Employer may, following written notice to the Contractor, carry out themselves or arrange for another contractor to carry out such measures as they consider appropriate on behalf of the Contractor. Any such actions by the Employer shall not affect or diminish the Contractor's obligations or responsibilities under the Contract.

(c) the Engineer may, following written notice to the Contractor specifying the breach or breaches of these Regulations by the Contractor, impose the fines stipulated in Sub-Clause 3.2. All deductions for fines by the Engineer will be subject to the approval of the Employer.

(d) the Engineer may, by written notice of suspension to the Contractor, suspend all payments to the Contractor under the Contract if the Contractor fails to rectify any breach of the Regulations within the period specified by the Engineer, provided that such notice of suspension:

(i) shall specify the nature of the failure or failures; and

(ii) shall request the contractor to remedy each such failure within a specified period after receipt by the Contractors of such notice of suspension.

Such suspension of payment will remain in force until such time as the Contractor has rectified the breach or breaches to the satisfaction of the Engineer. No interest shall be paid on the suspended payments.

3.1.2 Failure to comply with the Regulations or requirements shall be considered a breach of contract by the Contractor and may result in termination of the Contract by the Employer.

3.1.3 In the event of the Employer or Engineer taking action based on Sub-Clause 3.1.1(a) or (b) or 3.1.2, the Contractor shall not be entitled to any additional costs or extension to the Contract Completion Date.

3.1.4 All costs incurred by the Employer pursuant to Sub-Clause 3.1.1(b) and the fines imposed on the Contractor by the Engineer under Sub-Clause 3.1.1(c) shall be deducted from amounts otherwise due to the Contractor.

3.2 Fines

3.2.1 Failures by the Contractor to comply with the Regulations or requirements are classified as follows:

F1 - breaches of Sub-Clause 5.6 (personal protective equipment);
F2 - breaches of Clause 7 (work in Public Areas);
F3 - breaches other than F1 and F2.

3.2.2 The basic fine for each classification in Sub-Clause 3.2.1, is as follows:

for F1 - US$100;
for F2 - US$500;
for F3 - US$200.

3.2.3 Fines will be applied as follows:

(a) for the first breach of each regulation or requirement - the basic fine. If the same or similar breaches occur in different situations or locations at the same time, the Engineer may apply fines for each situation or location; this will not apply to breaches related to personal protective equipment.

(b) for a second or subsequent breach of the same Regulation or requirement or failure to rectify a previous failure within the time specified by the Engineer - twice the basic fine.

4 General Requirements

4.1 Preamble

4.1.1 All references to safety shall be deemed to include health and the environment.

4.2 Safety Officer

4.2.1 The Contractor shall appoint a competent Safety Officer who shall be responsible for safety, health and the environment. The Safety Officer shall be given sufficient time by the Contractor to carry out his duties; minimum requirements shall be as follows:

Workforce on Site of over 250	-	full time Safety Officer;
Workforce on Site of 100-250	-	50% of Safety Officer's time;
Workforce on Site below 100	-	as required for the Works but a minimum of 5 hours per week of Safety Officer's time where more than 20 workers.

4.2.2 The Contractor shall provide the Safety Officer with appropriate identification, including a white hard hat with red cross symbol and a identification badge. The appointment of the Safety Officer shall be in writing and copied to the Engineer. The appointment shall include specific instructions to enforce these Regulations and delegated authority to take any action, measure or to issue instructions regarding their enforcement. All persons on Site shall be made aware of the name and authority of the Safety Officer and instructed to comply with any instruction or direction on safety matters, verbal or in writing, issued by the Safety Officer.

4.2.3 The Safety Officer shall be provided with a mobile phone or other similar means of communication. The Safety Officer shall be accessable and available at all times including outside normal working hours.

4.3 Safety Training

4.3.1 The Contractor shall provide safety induction training for all site personnel upon starting on site.

4.3.2 The Contractor shall provide safety refresher/reinforcement training at regular intervals for his staff.

4.4 Safety Meetings

4.4.1 The Contractor shall hold regular safety meetings to provide safety instructions and receive feedback from site personnel on safety, health and environmental matters. A weekly Safety Meeting shall be chaired by the Safety Officer and minutes shall be taken of the meeting. The meeting/minutes shall cover all relevant issues including actions to be taken. A copy of the minutes shall be given to the Engineer. The Safety Officer should attend the Contractor's weekly site meetings and "Safety" should be an item on the agenda.

4.5 Safety Inspections

4.5.1 The Safety Officer shall make regular safety inspections of the work site. The Safety Officer shall prepare a report of each inspection. This report shall include details of all breaches of these Regulations and any other matters or situations relating to safety found during the inspection, instructions issued by the Safety Officer and actions taken by the Contractor. A copy of the Safety Officer's inspection reports shall be given to the Engineer.

4.6 Control of Substances Hazardous to Health

4.6.1 Hazardous materials shall be stored in approved safety containers and handled in a manner specified by the manufactures and/or prescribed by relevant Authorities (see Sub-Clause 2.5).

4.6.2 Only properly trained and equipped personnel shall handle hazardous materials.

4.7 Potential Hazards

4.7.1 The Contractor shall inform employees of potential hazards, take appropriate steps to reduce hazards and be prepared for emergency situations.

4.7.2 The Contractor shall make an assessment of every operation involving hazardous substances. The assessment shall be recorded on a Hazardous and Flammable Substances Assessment Method Statement which shall be submitted to the Engineer prior to the delivery and use of the substance on Site.

4.8 Accident Reporting

4.8.1 The Contractor shall report all accidents and dangerous occurrences to the Engineer. The Contractor shall prepare a report on each accident or dangerous occurrence and a copy of the report, together with witness statements and any other relevant information, shall be submitted to the Engineer. A reportable accident or dangerous occurrence shall include any accident to any person on Site requiring medical attention or resulting in the loss of working hours or any incident that resulted, or could have resulted, in injury, damage or a danger to the Works, persons, property or the environment.

4.8.2 In the event of an accident or dangerous occurrence, the Contractor shall be responsible for completing all statutory notifications and reports. Copies of all statutory notifications and reports shall be passed to the Engineer.

4.8.3 All accidents and dangerous occurrences shall be recorded in a Site Accident Book. The Site Accident Book shall be available at all times for inspection by the Engineer.

4.8.4 The Contractor shall immediately rectify any situation or condition that could result in injury, damage or a danger to the Works, person, property or the environment. If the situation or condition cannot be corrected immediately, the Contractor shall provide temporary barriers and appropriate warning signs and devices and/or take other appropriate action necessary for the protection of persons, property and the environment.

4.9 Notices, Signs, Etc

4.9.1 All safety, health, environmental and other notices and signs shall be clearly displayed and written in both Arabic and English. All requirements, instructions, procedures, etc issued by the Contractor concerning these Regulations shall be printed in both Arabic and English and displayed and readily available to Contractor's personnel.

4.10 First Aid and Medical Attention

4.10.1 The Contractor shall have comprehensive First Aid Kit(s) on Site at all times. First Aid Kits shall be conveniently located and clearly identifiable.

4.10.2 The Contractor shall have one employee on site trained in first aid for every 25 employees. Such persons shall be provided with appropriate identification, including a red hard hat with a white "red cross" symbol and a identification badge.

4.10.3 The Contractor shall make contingency arrangements for calling a Doctor and transporting injured persons to hospital. The telephone numbers of the emergency services and the name, address and telephone number of the Doctor and nearest hospital shall be prominently displayed in the Contractor's site office.

4.11 Employee Qualifications and Conduct

4.11.1 The Contractor shall employ only persons who are fit, qualified and skilled in the work to be preformed. All persons shall be above the minimum working age.

4.11.2 Contractor's personnel shall use the toilet facilities provided by the Contractor.

4.11.3 The Contractor shall ensure:

(a) that no firearms, weapons, controlled or illegal substances or alcoholic beverages are brought onto the Site and that no personnel under the influence of alcohol or drugs are permitted on Site.

(b) that all personnel obey warning signs, product or process labels and posted instructions.

(c) that drivers or operators of vehicles, machinery, plant and equipment follow the rules for safe operations. Drivers shall wear seat belts and obey all signs and posted speed limits.

5 Safety Requirements

5.1 Personal Protective Equipment

5.1.1 The Contractor shall provide personal protective equipment, including hard hats, safety glasses, respirators, gloves, safety shoes, and such other equipment as required, and shall take all measures or actions for the protection and safety of Contractor's personnel.

5.1.2 Non-metallic hard hats shall be worn at all times by all personnel at the worksite with the exception of those areas where the Engineer has indicated it is not necessary to do so.

5.1.3 Safety glasses shall meet international standards and be available for use and worn in specified worksite areas. As a minimum, safety glasses shall be worn for the following types of work: hammering, chipping, welding, grinding, use of electrically powered or pneumatic equipment, insulation handling, spray painting, working with solvents, and other jobs where the potential of an eye injury exists. Face shields and/or monogoggles shall be worn where possible exposure to hazardous chemicals, cryogenic fluids, acids, caustics, or dust exists and where safety glasses may not provide adequate protection.

5.1.4 When handling acids, caustics, and chemicals with corrosive or toxic properties, suitable protection, such as acid suits or chemical resistant aprons and gloves, shall be worn to prevent accidental contact with the substance.

5.1.5 Personnel shall not be permitted to work whilst wearing personal clothing or footwear likely to be hazardous to themselves or others.

5.1.6 The wearing of safety shoes with steel reinforced toes is recommended for all Contractor's personnel on site. In all cases, Contractor's personnel shall wear substantial work shoes that are commensurate with the hazards of the work and the worksite area.

5.1.7 Hearing protection, including muffs, plugs or a combination thereof, shall be provided for all personnel operating in areas where the noise level exceeds 90 decibels. Such protection shall also be provided for operators working with equipment exceeding such a level. This may include equipment such as excavators, shovels, jackhammers, saws, drills, grinders, and the like are being used.

5.1.8 The Contractor shall encourage employees to wear substantial work gloves whenever practical and safe to do so.

5.2 Fire Protection and Prevention

5.2.1 The Contractor shall comply with fire protection instructions given by the Authorities having jurisdiction in regard to fire protection regulations.

5.2.2 The Contractor shall, upon moving on site, provide to the Engineer and the Authorities a fire prevention and evacuation plan. This shall include drawing(s) showing the fire assembly points. The fire prevention and evacuation plan and drawing(s) shall be updated from time to time as the Works progress. The Contractor shall ensure all personnel are fully informed on escape routes and assembly points and any changes thereto.

5.2.3 Fuel storage will not be permitted in construction work areas. Contractors may establish fuel storage tanks in special areas set aside for the purpose and approved by the Engineer. Storage tanks shall be adequately bunded to control spillage. Fire extinguishers shall be provided and installed in a suitable nearby location.

5.2.4 Highly combustible or volatile materials shall be stored separately from other materials and as prescribed by relevant authorities and under no circumstances within buildings or structures forming part of the permanent Works. All such materials shall be protected and not exposed to open flame or other situations which could result in a fire risk.

5.2.5 No combustible site accommodation shall be located inside or within 10 metres of a building or structure forming part of the permanent Works, Where units have to be used in these circumstances, they shall be constructed of non-combustible materials and have a half-hour fire rating inside to outside and outside to inside. Non-combustible furniture shall be used where practical.

5.2.6 All temporary accommodation and stores shall be provided with smoke detectors and fire alarms.

5.2.7 Smoking shall be banned in high risk areas.

5.2.8 Expanded polystyrene with or without flame retarding additive, polythene, cardboard and hardboard shall not be used as protection materials.

5.2.9 Plywood and chipboard shall only be used as protection on floors. Vertical protection shall be non-combustible. Debris netting and weather protection sheeting shall be fire retardant.

5.2.10 When using cutting or welding torches or other equipment with an open flame, the Contractor shall provide a fire extinguisher close by at all times. All flammable material shall be cleared from areas of hot works, or work locations prior to welding or

oxy/gas burning operations. All hot works shall cease half an hour before the end of a work shift to allow for thorough checking for fires or smoldering materials. Where appropriate, areas of hot works are to be doused in water before the shift ends.

5.2.11 An adequate number of fire extinguishers of types suited to the fire risk and the materials exposed shall be provided. These shall be placed in accessible, well-marked locations throughout the job site. Contractor's personnel shall be trained in their use. Extinguishers shall be checked monthly for service condition and replaced or recharged, as appropriate after use.

5.2.12 Only approved containers shall be used for the storage, transport and dispensing of flammable substances. Portable containers used for transporting or transferring gasoline or other flammable liquids shall be approved safety cans.

5.2.13 Fuel burning engines shall be shut off while being refueled.

5.2.14 Adequate ventilation to prevent an accumulation of flammable vapors shall be provided where solvents or volatile cleaning agents are used.

5.2.15 Flammables shall not be stored under overhead pipelines, cable trays, electrical wires, or stairways used for emergency egress.

5.2.16 Paints shall be stored and mixed in a room assigned for the purpose. This room shall be kept under lock and key.

5.2.17 Oily waste, rags and any other such combustible materials shall be stored in proper metal containers with self-closing lids and removed every night to a safe area or off site. Every precaution shall be taken to prevent spontaneous combustion.

5.3 Electrical Safety

5.3.1 All temporary electrical installations, tools and equipment shall comply with current regulations dealing with on-site electrical installations.

5.3.2 The Contractor shall establish a permit-to-work system for work on or in proximity to energized circuits of any voltage. Contractor's personnel shall not commence work on such circuits unless a permit to work has been issued and adequate safety measures have been taken and the work operation has been reviewed and approved by the Engineer.

5.3.3 Only authorized personnel shall be allowed to work or repair electrical installations and equipment.

5.3.4 Portable tools and equipment shall be 110 volt, unless otherwise agreed by the Engineer.

5.3.5 When portable or semi-mobile equipment operates at voltages in excess of 110 volts, the supply shall be protected by a Residual Current Device (RCD) regardless of any such device fitted to the equipment. The RCD must have a tripping characteristic of 30 milliamps at 30 milliseconds maximum.

5.3.6 All static electrically powered equipment, including motors, transformers, generators, welders, and other machinery, shall be properly earthed, insulated, and/or protected by a ground fault interruption device. In addition, the skin of metal buildings and trailers with electric service shall be earthed. Metal steps, when used, shall be securely fixed to the trailer.

5.3.7 Lampholders on festoon lighting shall be moulded to flexible cable and be of the screw in type. Clip on guards shall be fitted to each lamp unit.

5.3.8 All tungsten-halogen lamps shall be fitted with a glass guard to the element. These lamps must be permanently fixed at high level.

5.3.9 Electrical equipment shall be periodically inspected and repaired as necessary by competent persons.

5.3.10 Any work on electrical equipment and systems shall be made safe through locking, tagging, and/or isolation of the equipment before work commences. Prior to the start of the work, the equipment or systems shall be tested to insure that they have been properly de-energized and isolated.

5.3.11 Electrical repair work on energized systems shall be avoided whenever possible.

5.3.12 Electrical trouble shooting shall be conducted only after getting written approval of the Engineer.

5.3.13 Unauthorized personnel shall not enter enclosures or areas containing high voltage equipment such as switch gear, transformers, or substations.

5.4 Oxygen/Acetylene/Fuel Gases/Cartridge Tools

5.4.1 Compressed oxygen shall never be used in the place of compressed air.

5.4.2 Flash-back (Spark) arrestors shall be fitted to all gas equipment.

5.4.3 Liquid Petroleum Gas (LPG) cylinders shall not be stored or left in areas below ground level overnight. Cylinders must be stored upright.

5.4.4 The quantity of oxygen, acetylene and LPG cylinders at the point of work shall be restricted to a maximum of one day's supply. Cylinders shall be kept in upright vertical rack containers or be safely secured to a vertical support.

5.4.5 Cartridge tools shall be of the low velocity type. Operators must have received adequate training in the safe use and operation of the tool to be used.

5.5 Scaffolding/Temporary Works

5.5.1 No aluminum tube shall be used, except for proprietary mobile towers, unless otherwise agreed with the Engineer.

5.5.2 Drawings and calculations shall be submitted to the Engineer, prior to commencement of work on site, for all Temporary Works, including excavations, falsework, tower cranes, hoists, services and scaffolding. Design shall conform to international standards.

5.5.3 The Engineer will not approve Temporary Work designs but the Contractor shall take account of any comments on such designs made by the Engineer.

5.5.4 The Contractor shall inspect and approve all Temporary Works after erection and before access, loading or use is allowed. Completed and approved Temporary Works shall be tagged with a scaff-tag or similar safety system and the Safe Structure insert displayed. For scaffolding, one tag shall be displayed every 32 m² of face area. A central record system shall be kept on all Temporary Work. Temporary Works shall be inspected weekly and similarly recorded.

5.5.5 All mobile scaffold towers shall be erected in accordance with the manufacture's instructions and a copy of these shall be submitted to the Engineer prior to any use on site. Additionally, all towers shall be erected complete with access ladder, safety rails and kick boards whatever the height.

5.5.6 The Contractor shall repair or replace, immediately, any scaffold including accessories, damaged or weakened from any cause.

5.5.7 The Contractor shall ensure that any slippery conditions on scaffolds are eliminated as soon as possible after they occur.

5.5.8 All scaffolds used for storing materials, for brick or block laying, for access to formwork or for any other purpose where materials may accidentally fall, shall be provided with wire mesh guards or guards of a substantial material, in addition to kick boards.

5.6 Use of Ladders

5.6.1 Manufactured ladders shall meet the applicable safety codes for wood or metal ladders. Metal ladders shall not be used where there is any likelihood of contact with electric cables and equipment. All metal ladders shall be clearly marked: "Caution - Do not use around electrical equipment".

5.6.2 Job made ladders shall not be permitted.

5.6.3 Extension or straight ladders shall be equipped with non-skid safety feet, and shall be no more than 12 m in height. The maximum height of a step ladder shall be 2 m. Ladders shall not be used as platforms or scaffold planks.

5.6.4 Ladders rungs and steps shall be kept clean and free of grease and oil.

5.6.5 Extension and straight ladders shall be tied off at the top and/or bottom when in use. Only one person shall be allowed on a ladder at a time.

5.6.6 Defective ladders shall be taken out of service and not used. Ladders shall not be painted and shall be inspected for defects prior to use.

5.7 Elevated Work

5.7.1 The Contractor shall provide all personnel, while working at an elevated position, with adequate protection from falls. Details of such protection shall be submitted to and approved by the Engineer.

5.7.2 The Contractor shall carry out daily inspections of all elevated work platforms. Defects shall be corrected prior to use.

5.7.3 Roofing & Sheet Material Laying

(a) A Method Statement detailing the procedures to be adopted shall be submitted to and agreed with the Engineer prior to commencement of work on site.

(b) Mobile elevating work platforms or the equivalent shall be used to install roofing and sheet materials wherever practicable and a suitable base is available.

5.7.4 Erection of Structures

(a) A Method Statement detailing the procedures to be adopted shall be submitted and agreed with the Engineer prior to commencement of work on site.

(b) Safety harnesses and lines shall be provided by the Contractor for use by the erection personnel and worn at all times.

(c) Mobile elevating work platforms or the equivalent shall be used to erect structures wherever practicable and a suitable base is available.

5.7.5 Mobile Elevating Work Platforms

Operators shall be trained in the safe use of such platforms and hold a current Certificate of Competence (see Sub-Clause 2.5).

5.7.6 Hoists

(a) A copy of the current Test Certificate (see Sub-Clause 2.5) shall be submitted to the Engineer before any hoist (personnel or material) is brought into operation on the site. Where the range of travel is increased or reduced a copy of the revised Test Certificate shall be submitted.

(b) Each landing gate shall be fitted with a mechanical or electrical interlock to prevent movement of the hoist when any such gate is in the open position.

(c) Safety harnesses must be worn and used by personnel erecting, altering and dismantling hoists.

5.7.7 Suspended Cradles

(a) Suspended cradles shall be installed, moved and dismantled by a specialist contractor.

(b) Suspended cradles shall comply with local regulations.

(c) All powered suspended cradles shall incorporate independent safety lines to overspeed braking devices and independent suspension lines for personal safety harness attachment.

5.8 Use of Temporary Equipment

5.8.1 The safe design capacity of any piece of equipment shall not be exceeded, nor shall the equipment be modified in any manner that alters the original factor of safety or capacity.

5.8.2 Mobile equipment shall be fitted with suitable alarm and motion sensing devices, including backup alarm, when required.

5.8.3 The Contractor shall ensure that the installation and use of equipment are in accordance with the safety rules and recommendations laid down by the manufacturer, taking into account the other installations already in place or to be installed in the future.

5.8.4 The Contractor shall inspect Equipment prior to its use on the Works and periodically thereafter to ensure that it is in safe working order. Special attention shall be given to such items as cables, hoses, guards, booms, blocks, hooks and safety devices. Equipment found to be defective shall not be used and immediately removed from service, and a warning tag attached.

5.8.5 Natural and synthetic fiber rope made of material such as manila, nylon, polyester, or polypropylene shall not be used as slings unless approved by the Engineer.

5.8.6 Only trained, qualified and authorized personnel shall operate equipment. All drivers and operators shall hold a current Certificate of Training Achievement for the equipment being used (see Sub-Clause 2.5).

5.8.7 A safety observer shall be assigned to watch movements of heavy mobile equipment where hazards may exist to other personnel from the movement of such equipment, or where equipment could hit overhead lines or structures. The observer shall also ensure that people are kept clear of mobile equipment and suspended loads.

5.8.8 When mobile or heavy equipment is traveling onto a public thoroughfare or roadway, a flagman shall insure that traffic has been stopped prior to such equipment proceeding. While the mobile or heavy equipment is traveling on a public roadway, a trailing escort vehicle with a sign warning of a slow-moving vehicle that is dangerous to pass shall be provided.

5.8.9 Cranes:

(a) The Contractor shall give a minimum of 48 hours notice to the Engineer prior to bringing a mobile crane on site.

(b) No cranes shall be erected on the site without the prior approval of the Engineer. The Engineer may direct the Contractor as to locations where cranes may not be located. The Contractor shall take such directions into account when submitting his proposals for crane location points, base footings, pick up points and swing radius. Compliance with any such direction shall not entitle the Contractor to any extension of the Period of Completion or to any increase in the Contract Price.

(c) Safety harnesses shall be worn and used at all times by personnel engaged on the erection, alterations and dismantling of tower cranes.

(d) The Contractor shall provide a copy of the current Test Certificate (see Sub-Clause 2.5) to the Engineer before any crane (tower or mobile) is brought into operation on the Site.

(e) All lifting tackle must hold a current Test Certificate (see Sub-Clause 2.5). All lifting tackle must be thoroughly examined every 6 months and an inspection report raised.

(f) All fibrous/webb slings shall be destroyed and replaced 6 months after first use.

(g) All crane drivers/operators shall hold a Certificate of Training Achievement for the class of crane operated (see Sub-Clause 2.5).

(h) All banksman/slingers shall hold a Training Certificate from a recognized training agency (see Sub-Clause 2.5).

(i) Only certified slingers/banksmans shall sling loads or guide crane/load movement.

(j) The maximum weekly working hours of a crane driver or banksman shall be restricted to 60 hours.

(k) Under no circumstances, shall a crane or load come within 4 m of any energized overhead power line or other critical structure.

5.9 Locking-out, Isolating, and Tagging of Equipment

5.9.1 Equipment that could present a hazard to personnel if accidentally activated during the performance of installation, repair, alteration, cleaning, or inspection work shall be made inoperable and free of stored energy and/or material prior to the start of work. Such equipment shall include circuit breakers, compressors, conveyors, elevators, machine tools, pipelines, pumps, valves, and similar equipment.

5.9.2 Where equipment is subject to unexpected external physical movement such as rotating, turning, dropping, falling, rolling, sliding, etc., mechanical and/or structural constraints shall be applied to prevent such movement.

5.9.3 Equipment which has been locked-out, immobilized, or taken out of service for repair or because of a potentially hazardous condition shall be appropriately tagged indicating the reason it has been isolated and/or taken out of service.

5.9.4 Where safety locks are used for locking out or isolating equipment, the lock shall be specially identified and easily recognized as a safety lock.

5.10 Installation of Temporary or Permanent Equipment

5.10.1 During installation and testing the Contractor's specialist engineer shall be in attendance.

5.10.2 All control mechanism panel and wiring diagrams shall be available and printed in both Arabic and English.

5.11 Laser Survey Instruments

5.11.1 Details of the types and use of laser instruments shall be submitted and agreed with the Engineer.

5.12 Working in Confined Spaces

5.12.1 Confined spaces, including tanks, vessels, containers, pits, bins, vaults, tunnels, shafts, trenches, ventilation ducts, or other enclosures where known or potential hazards may exist, shall not be entered without prior inspection by and authorisation from the Site Safety Officer and the issuance of a Hazardous Work Permit.

5.12.2 Prior to entering the confined space, the area shall be completely isolated to prevent the entry of any hazardous substances or materials which could cause an oxygen deficient atmosphere. All equipment that could become energized or mobilized shall be physically restrained and tagged. All lines going into the confined space shall be isolated and/or blanked.

5.12.3 Personnel working in a confined space where emergency escape or rescue could be difficult, shall wear a safety harness attached to a lifeline.

5.12.4 A qualified attendant(s), trained and knowledgeable in job-related emergency procedures, shall be present at all times while persons are working within the confined space. The attendant shall be capable of effecting a rescue, have necessary rescue equipment immediately available, and be equipped with at least the same protective equipment as the person making entry.

5.12.5 All equipment to be used in a confined space shall be inspected to determine its acceptability for use. Where a hazard from electricity may exist, equipment utilized shall be of low voltage type.

5.12.6 The atmosphere within the confined space shall be tested to determine it is safe to enter. Acceptable limits are:

- oxygen: 19.5% lower, 22% higher;
- flammable gas: not to exceed 10% of lower explosion limit;
- toxic contaminants: not to exceed the permissible exposure limit.

Subsequent testing shall be done after each interruption and before re-entering the confined space, as well as at intervals not exceeding 4 hours. Continuous monitoring is preferable and may be necessary in certain situations.

5.12.7 Adequate ventilation shall be provided to ensure the atmosphere is maintained within acceptable limits.

5.13 Demolition

5.13.1 A detailed Method Statement detailing the demolition procedures/techniques to be used shall be submitted to and approved by the Engineer prior to commencement of work on site.

The Method Statement must include full details of measures to be taken to ensure that there are no persons remaining in the building/structure and to distance members of the public and Contractor's personnel from the building/structure prior to demolition.

5.14 Use of Explosives

5.14.1 The Contractor shall not use explosives without the written permission from the Engineer and relevant authorities (see Sub-Clause 2.5).

5.14.2 The Contractor shall observe all regulations regarding proper purchasing, transportation, storage, handling and use of explosives.

5.14.3 The Contractor shall ensure that explosives and detonators are stored in separate special buildings. These secured buildings shall be constructed, located and clearly marked in Arabic and English:

"DANGER - EXPLOSIVES"

all as approved by the Engineer and relevant authorities (see Sub-Clause 2.5).

5.14.4 The Contractor shall ensure that all possible precautions are taken against accidental fire or explosion, and ensure that explosives and detonators are kept in a proper and safe condition.

5.14.5 The Contractor shall ensure that explosives and detonators are always transported in separate vehicles and kept apart until the last possible moment and that metallic tools are not used to open boxes of explosives or detonators.

5.14.6 Blasting Procedure: the Contractor shall carry out blasting operations in a manner that will not endanger the safety of persons and property. The Contractor shall, along with other necessary precautions:

(a) clear all persons from buildings and the area affected by the blasting. All such persons shall be given adequate notice of the actual time and date of blasting,

(b) ensure that police and other local authorities are kept fully informed, in advance, of the blasting programme so that they may be present when blasting takes place if they so require,

(c) erect warning notices around the area affected that blasting operations are in progress,

(d) carry out a thorough search of buildings and the area affected prior to blasting,

(e) ensure that blasting is only carried out by experienced shot firers. Priming, charging, stemming and shot firing shall be carried out with greatest regard for safety and in strict accordance with the rules and regulations of the relevant authorities (see Sub-Clause 2.5).

(f) ensure that explosive charges are not excessive, charged boreholes are properly protected and proper precautions are taken for the safety of persons and property,

5.14.7 The Contractor shall maintain an up-to-date inventory of all explosives and explosive devices and shall submit a monthly report to the Engineer, detailing the use of all explosives by date and location.

5.15 Excavation and Trenching

5.15.1 The Contractor shall obtain an excavation permit from the relevant local authority before commencing excavation in any public place and he shall observe any restrictions imposed by the authority. He shall produce any such permit for the Engineer's inspection when requested to do so. If he fails to produce the permit, the Engineer shall have the right to order cessation of the relevant work.

5.15.2 The side of all excavations and trenches exceeding 1.3 meters in depth which might expose personnel or facilities to danger resulting from shifting earth shall be protected by adequate temporary supports or sloped to the appropriate angle of repose.

5.15.3 All excavations, slopes and temporary supports shall be inspected daily and after each rain, before allowing personnel to enter the excavation.

5.15.4 Excavations 1.3 metres or more in depth and occupied by personnel shall be provided with ladders as a means for entrance and egress. Ladders shall extend not less than 1 metre above the top of the excavation.

3.15.5 The Contractor shall provide adequate barrier protection to all excavations. Barriers shall be readily visible by day or night.

5.15.6 Excavated or other materials shall not be stored at least 0.65 metres from the side of excavations.

5.16 Concrete Reinforcement Starter Bars

5.16.1 The Contractor shall ensure concrete reinforcement starter bars are not a danger to personnel. Where permitted by the Engineer, starter bars shall be bent down. Alternatively, the starter bars shall be protected using either hooked starters, plastic caps, plywood covers or other methods agreed with the Engineer.

6 Environmental and Health Requirements

6.1 Protection of the Environment

6.1.1 The Contractor shall be knowledgeable of and comply with all environmental laws, rules and regulations for materials, including hazardous substances or wastes under his

control. The Contractor shall not dump, release or otherwise discharge or dispose of any such material without the authorisation of the Engineer.

6.1.2 Any release of a hazardous substance to the environment, whether air, water or ground, must be reported to the Engineer immediately. When releases resulting from Contractor action occur, the Contractor shall take proper precautionary measures to counter any known environmental or health hazards associated with such release. These would include remedial procedures such as spill control and containment and notification of the proper authorities.

6.2 Air Pollution

6.2.1 The Contractor, depending on the type and quantity of materials being used, may be required to have an emergency episode plan for any releases to the atmosphere. The Contractor shall also be aware of local ordinances affecting air pollution.

6.2.2 The Contractor shall take all necessary measures to limit pollution from dust and any wind blown materials during the Works, including damping down with water on a regular basis during dry climatic conditions.

6.2.3 The Contractor shall ensure that all trucks leaving the Site are properly covered to prevent discharge of dust, rocks, sand, etc.

6.3 Water Pollution

6.3.1 The Contractor shall not dispose of waste solvents, petroleum products, toxic chemicals or solutions in the city drainage system or watercourse, and shall not dump or bury garbage on the Site. These types of waste shall be taken to an approved disposal facility regularly, and in accordance with requirements of relevant Authorities. The Contractor shall also be responsible to control all run-offs, erosion, etc.

6.4 Solid Waste

6.4.1 General Housekeeping

(a) The Contractor shall maintain the site and any ancillary areas used and occupied for performance of the Works in a clean, tidy and rubbish-free condition at all times.

(b) Upon the issue of any Taking-Over Certificate, the Contractor shall clear away and remove from the Works and the Site to which the Taking-Over Certificate relates, all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave the said Works and Site in a clean condition to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials,

Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period.

6.4.2 Rubbish Removal and Disposal

(a) The Contractor shall comply with statutory and municipal regulations and requirements for the disposal of rubbish and waste.

(b) The Contractor shall provide suitable metal containers for the temporary storage of waste.

(c) The Contractor shall remove rubbish containers from site as soon as they are full. Rubbish containers shall not be allowed to overflow.

(d) The Contractor shall provide hardstandings for and clear vehicle access to rubbish containers.

(e) The Contractor shall provide enclosed chutes of wood or metal where materials are dropped more than 7 metres. The area onto which the material is dropped shall be provided with suitable enclosed protection barriers and warning signs of the hazard of falling materials. Waste materials shall not be removed from the lower area until handling of materials above has ceased.

(f) Domestic and biodegradable waste from offices, canteens and welfare facilities shall be removed daily from the site.

(g) Toxic and hazardous waste shall be collected separately and be disposed of in accordance with current regulations.

(h) No waste shall be burnt on Site unless approved by the Engineer.

6.4.3 Asbestos Handling and Removal

The Contractor shall comply with all local regulations regarding the handling of asbestos materials. In the absence of local regulations, relevant International Standards shall apply.

6.4.5 Pest Control

The Contractor shall be responsible for rodent and pest control on the Site. If requested, the Contractor shall submit to the Engineer, for approval, a detailed programme of the measures to be taken for the control and eradication of rodents and pests.

6.5 Noise Control

6.5.1 The Contractor shall ensure that the work is conducted in a manner so as to comply with all restrictions of the Authorities having jurisdiction, as they relate to noise.

6.5.2 The Contractor shall, in all cases, adopt the best practicable means of minimizing noise. For any particular job, the quietest available plant/and or machinery shall be used. All equipment shall be maintained in good mechanical order and fitted with the appropriate silencers, mufflers or acoustic covers where applicable. Stationary noise sources shall be sited as far away as possible from noise-sensitive areas, and where necessary acoustic barriers shall be used to shield them. Such barriers may be proprietary types, or may consist of site materials such as bricks or earth mounds as appropriate.

6.5.3 Compressors, percussion tools and vehicles shall be fitted with effective silencers of a type recommended by the manufacturers of the equipment. Pneumatic drills and other noisy appliances shall not be used during days of rest or after normal working hours without the consent of the Engineer.

6.5.4 Areas where noise levels exceed 90 decibels, even on a temporary basis, shall be posted as high noise level areas.

7 Additional Requirements for Work in Public Areas

7.1 General

7.1.1 These additional requirements shall apply to all works carried out in Public Areas.

7.1.2 Public Areas are defined as areas still used by or accessible to the public. These include public roads and pavements, occupied buildings and areas outside the Contractor's boundary fencing.

7.1.3 All work in Public Areas shall be carried out to minimise disturbance and avoid dangers to the public.

7.1.4 Before commencing work, the Contractor shall ensure that all necessary resources, including labour, plant and materials, will be available when required and that the works will proceed without delays and be completed in the shortest possible time. Periods of inactivity and slow progress or delays in meeting the agreed programme for the works, resulting from the Contractor's failure to provide necessary resources or other causes within the control of the Contractor, will not be accepted. In the event of such inactivity, slow progress or delays, the Contractor shall take immediate action to rectify the situation, including all possible acceleration measures to complete the works within the agreed programme. Details of the actions and acceleration measures shall be submitted to the Engineer. If the Engineer is dissatisfied with the Contractor's proposals, the Contractor shall take such further actions or measures as required by the Engineer. All costs incurred shall be the responsibility of the Contractor.

7.2 Method Statement

7.2.1 The Contractor shall submit to the Engineer a method statement for each separate area of work in Public Areas. The Method Statement shall include:

(a) a general description of the Works and methodology of how it will be carried out.

(b) details of the measures and temporary works to minimise disturbance and safeguard the public. These shall include temporary diversions, safety barriers, screens, signs, lighting, watchmen and arrangements for control of traffic and pedestrians and advance warning to be given to the public.

(c) details of temporary reinstatement and maintenance of same prior to final reinstatement.

(d) for works involving long lengths of trenches or works to be completed in sections, the lengths or sections of each activity (eg up to temporary reinstatement, temporary reinstatement, final reinstatement) to be carried out at at any one time.

(e) details of the availability of necessary resources (labour, plant, materials, etc) to complete the work.

(f) a programme showing start and completion dates and periods for all activities of each length or section, including temporary works, and the works overall.

(g) such further information as necessary or required by the Engineer.

7.2.2 The Contractor shall not commence work, including temporary works, until approval of the Contractor's Method Statement by the Engineer.

7.2.3 Method Statements shall be updated based on actual progress or as and when required by the Engineer.

7.3 Closure of Roads, Etc

7.3.1 The closure or partial closure of roads, pavements and other public areas will only be permitted if approved by the Relevant Authorities and the relevant closure permit has been issued by the Authority. The Contractor shall detail for each closure the extent of area to be closed, the reasons and duration of the closure and, where appropriate, proposed diversions. The Contractor shall produce the Closure Permit for inspection by the Engineer if requested. The Engineer shall have the right to order cessation of the relevant work if the Contractor does not produce the Closure Permit.

7.4 Trench and Other Excavations

7.4.1 The requirements covering trench and other excavations will depend on the location and type of the excavation and the potential risks to the public.

7.4.2 The following guidelines apply particularly to trenches but shall also apply to other types of excavations:

(a) before commencing work the Contractor shall:

- notify the Engineer on the location and duration of the work. An excavation permit signed by the Engineer must be issued in accordance with Sub-Clause 5.15.1 before excavation proceeds in any work location.;
- obtain permission from relevant authorities including the police when required;
- erect all temporary works such as barriers, warning signs, lighting, etc;
- have available adequate materials for temporary supports to sides of excavations and necessary labour, plant and materials to complete the work within the shortest possible time;

(b) in carrying out the works the Contractor shall, unless otherwise permitted or required by the Engineer:

not open more than one excavation within a radius of 250 metres;

- limit the length of trench excavation open at one time to 150 metres;
- maintain and alter or adapt all temporary works including supports to sides of excavations;
- remove all surplus excavated material the same day it is excavated;
- complete the works, including final reinstatement within ten days;
- where final reinstatement is not achieved within the required time, to carry out temporary reinstatement;
- ensure that any temporary reinstatement is maintained at the correct level until final reinstatement is achieved.

7.4.3 The above guidelines shall not relieve the Contractor of his obligations and responsibilities.

7.5 Safety Barriers

7.5.1 Safety barriers shall be provided to the perimeter of work areas and to trench and other types of excavations and to existing openings such as manholes, drawpits and the like. When exposed to the public, safety barriers shall be provided to both sides of trenches and around all sides of openings.

7.5.2 The Contractor shall provide details of the type or types of safety barriers for each excavation for the approval of the Engineer prior to commencing work. No work shall commence until the safety barriers are in place.

7.5.3 The type of safety barrier used shall be appropriate to the particular location and the potential risks to the public. Examples of different types of safety barriers are given below:

- Type 1 - excavated material;
- Type 2 - non-rigid barrier of rope or florescent tape strung between metal rods driven into the ground;
- Type 3 - rigid barrier of timber, steel or concrete. Such barriers could be in the form of horizontal rail(s) or sheet material secured to posts driven or concreted into the ground.

7.5.4 The following are guidelines on the type of safety barriers that could be used in differing situations. They apply particularly to trenches but also apply to other types of excavations, existing openings and to the perimeter of work areas:

- areas not subject to vehicular traffic - Types 1 or 2;
- roadways (low traffic speed) - Types 1 or 2;
- roadways (high traffic speed) - Types 1 or 3.

7.5.5 The above examples of the types of barriers and the guidelines on situations in which they could be used shall not relieve the Contractor of his obligations and responsibilities.

8 Contractor's Site Check List

8.1 A sample Contractor's Site Check List is included in Annex 1. This is included to assist contractors should they wish to introduce such a system as part of their site management procedures. The list is is not exhaustive and further items will need to be added by the Contractor.

8.2 The list is issued for guidance only, and does not, in any way, revise or limit the requirements covered elsewhere in these Regulations.

Annex 1

Sample Contractor's Site Check List

Safe Access:

- arrangements for visitors and new workers to the site
- safe access to working locations
- walkways free from obstructions
- edge protection to walkways over 2m above ground
- holes fenced or protected with fixed covers
- tidy site and safe storage of materials
- waste collection and disposal
- chutes for waste disposal, where applicable
- removal or hammering down of nails in timber
- safe lighting for dark or poor light conditions
- props or shores in place to secure structures, where applicable

Ladders:

- to be used only if appropriate
- good condition and properly positioned
- located on firm, level ground
- secure near top. If not possible, to be secured near the bottom, weighted or footed to prevent slipping
- top of ladder minimum 1 metre above landing place

Scaffolding:

- design calculations submitted
- proper access to scaffold platform
- properly founded uprights with base plates
- secured to the building with strong ties to prevent collapse
- braced for stability
- loadbearing fittings, where required
- uprights, ledgers, braces and struts not to be removed during use
- fully boarded working platforms, free from defects and arranged to avoid tipping or tripping
- securely fixed boards against strong winds
- adequate guard rails and toe boards where scaffold 2m above ground
- designed for loading with materials, where appropriate
- evenly distributed materials
- barriers or warning notices for incomplete scaffold (ie not fully boarded)
- weekly inspections and after bad weather by competent person
- record of inspections

Excavation:

- underground services to be located and marked and precautions taken to avoid them
- adequate and suitable timber, trench sheets, props and other supporting materials available on site before excavation starts
- safe method for erecting/removal of timber supports
- sloped or battered sides to prevent collapse
- daily inspections after use of explosives or after unexpected falls of materials
- safe access to excavations (eg sufficiently long ladder)
- barriers to restrict personnel/plant
- stability of neighbouring buildings
- risk of flooding
- materials stacked, spoil and vehicles away from top of excavations to avoid collapse
- secured stop blocks for vehicles tipping into excavations

Roof work:

- crawling ladders or boards on roofs more than 10 degrees
- if applicable, roof battens to provide a safe handhold and foothold
- barriers or other edge protection
- crawling boards for working on fragile roof materials such as asbestos cement sheets or glass. Guard rails and notices to same
- rooflights properly covered or provided with barriers
- during sheeting operations, precautions to stop people falling from edge of sheet
- precautions to stop debris falling onto others working under the roof work

Transport and mobile plant:

- in good repair (eg steering, handbrake, footbrake)
- trained drivers and operators and safe use of plant
- secured loads on vehicles
- passengers prohibited from riding in dangerous positions
- propping raised bodies of tipping lorries prior to inspections
- control of on-site movements to avoid danger to pedestrians, etc
- control of reversing vehicles by properly trained banksmen, following safe system of work

Machinery and equipment:

- adequate and secured guards in good repair to dangerous parts, eg exposed gears, chain drives, projecting engine shafts

Cranes and lifting appliances:

- weekly recorded inspections
- regular inspections by a competent persons
- test certificates

- competent and trained drivers over 18 years of age
- clearly marked controls
- checks by driver and banksman on weight of load before lifting
- efficient automatic safe load indicator, inspected weekly, for jib cranes with a capacity of more than one tonne
- firm level base for cranes
- sufficient space for safe operation
- trained banksman/slinger to give signals and to attach loads correctly, with knowledge of lifting limitations of crane
- for cranes with varying operating radius, clearly marked safe working loads and corresponding radii
- regularly maintenance
- lifting gear in good condition and regularly examined

Electricity:

- measures to protect portable electric tools and equipment from mechanical damage and wet conditions
- checks for damage to or interference with equipment, wires and cables
- use of the correct plugs to connect to power points
- proper connections to plugs; firm cable grips to prevent earth wire from pulling out
- "permit-to-work" procedures, to ensure safety
- disconnection of supplies to overhead lines or other precautions where cranes, tipper lorries, scaffolding, etc might touch lines or cause arcing

Cartridge operated tools:

- maker's instruction being followed
- properly trained operators, awareness of dangers and ability to deal with misfires
- safety goggles
- regular cleaning of gun
- secure place for gun and cartridges when not in use

Falsework/formwork:

- design calculations submitted
- method statement dealing with preventing falls of workers
- appointment of falsework coordinator
- checks on design and the supports for shuttering and formwork
- safe erection from steps or proper platforms
- adequate bases and ground conditions for loads
- plump props, on level bases and properly set out
- correct pins used in the props
- timberwork in good condition
- inspection by competent person, against agreed design before pouring concrete

Risks to the Public:

- identify all risks to members of the public on and off site, eg materials falling from scaffold etc., site plant and transport (access/egress) and implement precautions, eg scaffold fans/nets, banksmen, warning notices etc
- barriers to protect/isolate persons and vehicles
- adequate site perimeter fencing to keep out the public and particularly children. Secure the site during non-working periods
- make safe specific dangers on site during non-working periods, eg excavations and openings covered or fenced, materials safely stacked, plant immobilised, ladders removed or boarded

Fire - general:

- sufficient number and types of fire extinguishers
- adequate escape routes, kept clear
- worker awareness of what to do in an emergency

Fire - flammable liquids:

- proper storage area
- amount of flammable liquid on site kept to a minimum for the day's work
- smoking prohibited; other ignition sources kept away from flammable liquids
- proper safety containers

Fire - compressed gases, eg oxygen, LPG, acetylene:

- properly stored cylinders
- valves fully closed on cylinders when not in use
- adopt "hot work" procedures
- site cylinders in use outside huts

Fire - other combustable materials:

- minimum amount kept on site
- proper waste bins
- regular removal of waste material

Noise:

- assessment of noise risks
- noisy plant and machinery fitted with silencers/muffs
- ear protection for workers if they work in very noisy surroundings

Health:

- identify hazardous substances, eg asbestos, lead, solvents etc and assess the risks
- use of safer substances where possible
- control exposure by means other than by using protective equipment
- safety information sheets available from the supplier
- safety equipment and instructions for use
- keep other workers who are not protected out of danger areas

- testing of atmosphere in confined spaces; provision of fresh air supply if necessary. Emergency procedures for rescue from confined spaces

Manual handling:

- avoid where risk of injury
- if unavoidable, assess and reduce risks

Protective clothing:

- suitable equipment to protect the head, eyes, hands and feet where appropriate
- enforce wearing of protective equipment

Welfare:

- suitable toilets
- clean wash basin, hot/warm water, soap and towel
- room or area where clothes can be dried
- wet weather gear for those working in wet conditions
- heated site hut where workers can take shelter and have meals with the facility for boiling water
- suitable first aid facilities

Work in Public Areas

- all risks to the public identified
- method statement approved
- road closures approved
- temporary diversions in place
- safety barriers erected/maintained
- safety signs and lighting installed/maintained
- labour, materials, plant and other resources sufficient to meet programme
- temporary reinstatement completed and properly maintained
- permanent reinstatement completed at earliest possible date

UNITED NATIONS

DEVELOPMENT PROGRAMME
LEBANON

PROFESSIONAL SERVICES FOR THE DESIGN AND SUPERVISIONS OF REHABILITATION AND CONSTRUCTION PROJECTS ON LONG TERM AGREEMENT (LTA) basis

Ref.: LEB/CO RFP/11/17

Construction of a Homemade Food Market in Anjar

VOLUME 2
SPECIFICATIONS

PART 1
CIVIL, STRUCTURAL AND ARCHITECTURAL
(R1)

Ref: L-2017-03-C
OCTOBER 2017

CONSTRUCTION OF A HOMEMADE FOOD MARKET
ANJAR - LEBANON

VOLUME 2
SPECIFICATIONS

PART 1
CIVIL, STRUCTURAL AND ARCHITECTURAL

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CHAPTER ONE
SITE PREPARATION & DEMOLITION

CHAPTER ONE
SITE PREPARATION & DEMOLITION

1.1 GENERAL

1.1.1 SCOPE OF WORK

The work comprises of the construction of Homemade Product Market and do the external works that are related to the Market.

1.1.2 SITE PROTECTION

The contractor should take all measures to protect the site and to protect the users during the rehabilitation period as per the Engineer instructions.

1.1.3 At the beginning of the works, the contractor should clean the site and the surrounding from all obstacles and remove all debris to outside the site.

1.1.4 After the completion of works, the contractor should clean the site and works location and make good all places related to his works.

CHAPTER TWO
EXTERNAL WORKS

CHAPTER TWO
EXTERNAL WORKS

2.1 EXCAVATION AND EARTHWORK

SUMMARY

A. This section includes the following:

1. Excavating and backfilling for structures, roads and walkways.

DEFINITIONS

A. Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

D. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular base, concrete blinding layer, base course or topsoil materials.

PROJECT CONDITIONS

A. Use of Explosives: Use of explosives is not permitted.

B. Protection of Persons and Property.

1. Barricade open excavations occurring as part of this work and post with warning lights.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3. Perform excavation by hand.

STORAGE OF EXCAVATED MATERIALS

A. Stockpile all satisfactory excavated materials which are to be re-used for backfill and fill, where directed. Place, grade, and shape stockpiles for proper drainage, and locate away from edge of excavations.

BACKFILL AND FILL

A. General: Place soil material in layers to required subgrade elevations.

1. Under walkways: use satisfactory excavated or imported material, approved by the Engineer.

B. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Removal of trash and debris from excavation.

2. Permanent or temporary horizontal bracing is in place on horizontally supported wall.

PLACEMENT AND COMPACTION

A. Placement and compaction methods and equipment shall be approved by the Engineer. Heavy steel and pneumatic rollers are not allowed to be used inside building areas.

B. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by Engineer if soil density tests indicate inadequate compaction.

Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D 1557 :

1. Under structures, compact top 300 mm of subgrade and each layer of backfill or fill material at 95 percent maximum density.

2. Under lawn or unpaved areas, compact top 150 mm of subgrade and each layer of satisfactory soil material at 90 percent maximum density.

3. Under walkways, compact top 150 mm of subgrade and each layer of satisfactory soil material at 95 percent maximum density.

BUILDING SLAB BASE COURSE

A. General: Base course consists of placement of granular base material, in layers of indicated thickness, over subgrade to support concrete building slabs.

B. Placing: Place granular base material on prepared subgrade in layers of uniform thickness, conforming to indicated cross-section and thickness. Compact to 95% maximum density in accordance with ASTM D 1557.

1. When a compacted granular base course is indicated to be 150mm thick or less, place material in a single layer. When indicated to be more than 150mm thick, place material in equal layers, except no single layer more than 150mm or less than 75mm in thickness when compacted.

DISPOSAL

A. Unsatisfactory excavated material, trash, debris and other waste materials:

1. Remove from the site and dispose of legally, at Contractor's expense.

B. Satisfactory excavated material excess, surplus to backfill and fill requirements:

1. Remove from the site and dispose of legally, at Contractor's expense.

2.2 ROAD BASE COURSE

PART 1 - GENERAL

SUMMARY

A. The extent of the work is shown on the drawings and includes providing, spreading and compacting granular road base in compliance with the specifications and in conformity with grade, lines and thickness shown on the drawings.

PART 2 - PRODUCTS

GRANULAR ROAD BASE

A. General: Sound, naturally occurring material, or angular crushed stone, clean and free from organic matter and unsuitable material or other deleterious substances and be in such condition that it can be readily compacted under watering and rolling to form a firm and stable base.

PART 3 - EXECUTION

SUBGRADE PREPARATION

A. Check subgrade for conformity with elevations and section immediately before placing granular base. Materials are only to be placed on subgrades approved by the Engineer.

PLACING OF GRANULAR BASE

A. Deliver granular base material as a uniform mixture and place on the road bed by means of method approved by the Engineer controlled mechanical spreader, and at a uniform quantity per linear metre and at rate which will provide the required compacted thickness specified. Avoid segregation of material and material not uniform in mixture. Place material in compacted layers at optimum moisture content of approximately equal thickness. Unless otherwise approved thickness is not to exceed 150 mm for any one layer. When placed in 2 or more layers, permit first layer to dry just sufficient for stability during placing of the subsequent layer. Permit the completed base to dry just sufficiently for stability during placing of any covering materials.

COMPACTING AND GRADE TOLERANCE

A. Carry out plate bearing tests in accordance with ASTM D 1196 . At least one (1) Plate bearing test shall be carried out at selected locations for every 200 m2 of granular base. The bearing value of the granular base is not to be less than 1200 Kp using 300 mm diameter plate for 5 m deflection and 10 repetitions.

B. The surface of the finished base shall not vary by more than 10 mm when tested with a 3m straightedge when placed on, and parallel or perpendicular to the centre line of the roadway and the compacted base shall not vary by more than +5/-10 mm from the required elevation. Correct all depressions and humps exceeding the specified tolerances.

2.3 PRECAST CONCRETE PAVEMENTS AND CURBS

PART 1 - GENERAL

SUMMARY

A. The extent of precast concrete pavements and curbs is indicated on drawings. Types include:

1. Tile: walkway and area pavements.
2. Curb: at roadways and car parks.

B. The Contractor shall engineer and design all precast concrete pavement and curb assemblies, including, sub base, tooling, control joints and locations, and all other details and junctures with other materials and systems, to provide pavements and curb installations.

QUALITY ASSURANCE

A. Codes and Standards: conform and comply with ASTM or BS or alternative equivalent standards acceptable to the Engineer which establish minimum qualitative and quantitative standards for the materials, production and installation of precast concrete paves tiles and rood curbs.

B. If units are not produced at precast concrete fabricating plant, maintain quality control procedures and conditions acceptable to Engineer.

DELIVERY, STORAGE AND HANDLING

A. Deliver precast concrete units to the site in such quantities and at such times to ensure continuity of installation. Store units at site in such manner as to prevent cracking, chipping, distortion, staining or other physical damage.

PART 2 - PRODUCTS

MATERIALS

A. Precast Concrete Materials: Comply with the relevant requirements specified for cast in place concrete materials.

B. Mortar Bedding and Grout Materials: comply with the relevant requirement specified for unit masonry mortar and grout materials.

C. Joint Filler: Premoulded bituminous fibreboard.

MIXES

A. Tiles and Curbs: Prepare design mixes for each type of precast concrete unit to achieve minimum Class B cast in place concrete characteristics.

B. Base and Backing: cast in place concrete, Class C.

C. Mortar Bedding and Grout: Cement and sand proportioned by volume in parts 1:3.

FABRICATION

A. General: Tiles and curbs may either be obtained from an approved manufacturer or otherwise manufactured on site by the Contractor.

B. Production cast and cure precast units by approved methods conforming to referenced standards and a manufacturing system which includes .

1. Mechanically vibrated molds.

2. Hydraulically applied pressure.

3. Curing by totally immersing in water for at least 24 hours after initial set has taken place, or other approved method.

PRECAST CONCRETE PRODUCTS

A. Tile Pavers: Plain face with square edges:

1. Surface: Smooth, non-slip.

2. Dimensions: As indicated:

   a. 600mm x 600mm x 10mm thick, or
   b. 600mm x 600mm x 20mm thick

3. Colour : Grey.

B. Curbs: plain with square edges and ends.

1. Dimensions: approved uniform lengths to profiles as indicated on drawings or otherwise required.

2. Colour: Grey.

PART 3 - EXECUTION

PREPARATION AND INSTALLATION

A. Subgrades: Prepare and compact subgrade formations to 90% maximum density or 70% relative density.

B. Curbs:

1. Base and Backing: Place compact and cure cast in place concrete curb. Foundation as indicated or required. Place and compact 150mm wide curb backing, up to the under side of adjacent pavements.

2. Bedding and Jointing: set curb and grout up joints in cement mortar. Point joints smooth and flush with curb.

C. Tile Pavements:

1. Base: Place, compact and cure cast in place concrete sub base; 100mm thick bed unless otherwise indicated or required.

2. Bedding and Jointing: Set pavers and grout joints in cement mortar. Points and tool joints grooved, to a uniform depth of 3mm.

D. Control Joints: Install joint filler as indicated or required at pavement and curb control joint locations.

REPAIR, CLEANING AND PROTECTION

A. Remove and replace unit pavers and curbs which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units and install in same manner as original units, with same joint treatment to eliminate evidence of replacement.

B. Cleaning: Remove excess mortar/grout from exposed surface, wash and scrub clean.

C. Protect pavements and curbs from damage and wear and maintain conditions in a manner acceptable to the engineer.

CHAPTER FOUR
MASONRY

CHAPTER FOUR
MASONRY

4.1 UNIT MASONRY

PART 1 - GENERAL

DESCRIPTION OF WORK

A. Extent of each type of masonry work is indicated on Drawings.

B. Types of masonry work required include:

1. Concrete unit masonry.

QUALITY ASSURANCE

A. Unit Test Methods: Test the following materials by sampling and batch methods indicated

1. Concrete Masonry Units: Batch test sample blocks for compressive strength whenever required by the Engineer. Each test will comprise the destructive testing of twelve sample blocks selected by the Engineer. The minimum compressive strength for the gross area of any hollow block shall be 20 kg/cm2, and the average compressive strength for the gross area of all twelve blocks together shall be not less than 35 kg/cm2. If a test does not meet the compressive strength requirements, the entire batch from which the samples were selected will be rejected and removed from the site.

2. Mortars and Grouts: Test no less frequently than is required to evaluate mortars and grouts used to install each batch of masonry units from which samples are taken for testing.

PART 2 - PRODUCTS

MASONRY UNITS

A. General: Comply with referenced standards and other requirements indicated below:

1. Provide concrete masonry unit special shapes where required for corners, jambs, sash, control joints, headers, bonding and other special conditions.

    a. Provide square-edged units for outside corners, except where indicated otherwise.

B. Concrete Blocks: Provide units complying with characteristics indicated below:

1. Manufacture: produce blocks from cement and sand 1:5 mix (300 kg cement to 1m3 sand) in vibrated pressure machine moulds. Adjust the mix as necessary to achieve compressive strength requirements.
2. Size: Manufacturer's standard units with nominal face dimensions of 400mm long x 200 mm high, of thicknesses indicated.
3. Type: unless otherwise shown on the drawings, concrete masonry units shall be hollow blocks of a design approved by the Engineer.

MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I; BS 12.

B. Hydrated Lime: ASTM C 207, Types S; BS 890 class B.

C. Sand Aggregate: ASTM C 144; BS 1200 Table I, washed and mechanically graded.

D. Water: Clean and potable.

JOINT REINFORCEMENT AND TIES

A. Materials: Comply with requirements indicated below and obtain approval of the Engineer for each type of joint reinforcement and tie for size and other characteristics.

B. Wall Ties: galvanized steel ties conforming to BS. 1243.

C. Joint Reinforcement: Provide approved galvanized steel welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 3000 mm, with prefabricated corner and tee units, and complying with requirements indicated below:

1. Width: Fabricate joint reinforcement in units with widths of approximately 50 mm less than nominal width of walls and partitions as required to provide mortar coverage of not less than 16 mm on joint faces exposed to exterior and 12 mm elsewhere.
2. Wire Size: 4 mm diameter.
3. Type: Ladder design, single side rods with perpendicular cross rods spaced not more than 400mm overall centres.

MISCELLANEOUS MASONRY ACCESSORIES

A. Reinforcing Bars.

B. Premolded Control Joint Strips.

MORTAR AND GROUT MIXES

A. General: Do not add admixtures.

1. Do not use calcium chloride in mortar or grout.

B. Mixing: Combine and thoroughly mix cementitious, water and aggregates in a mechanical batch mixer; comply with ASTM or BS standards for mixing time and water content.

C. Mortar for Unit Masonry: Comply with ASTM or BS; Proportion mixes , for types of mortar required, unless otherwise indicated.

1. Limit cementitious materials in mortar to Portland cement-lime.

PART 3 - EXECUTION

INSTALLATION, GENERAL

A. Do not wet concrete masonry units.

B. Thickness: Build masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.

C. Build chases and recesses as shown or required for the work of other trades. Provide not less than 200 mm of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

D. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

E. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.

1. Use dry cutting saws to cut concrete masonry units.

LAYING MASONRY WALLS

A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.

B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.

C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a Wythe in running bond or bonded by lapping not less than 50 mm. Bond an interlock each course of each Wythe at corners. Do not use units with less that nominal 100 mm horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.

MORTAR BEDDING AND JOINTING

A. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

B. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 9 mm joints.

C. Cut joints flush for masonry walls, which are to be concealed or to be covered by other materials, unless otherwise indicated.

D. Rake out joints on faces of blockwork, which are to be rendered or plastered, to a depth of 10 mm, as the work proceeds.

E. Tool exposed joints slightly concave using a jointer larger than joint thickness, unless otherwise indicated, as the work proceeds.

F. Remove masonry units disturbed after lying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units, which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

G. Collar Joints: After each course is laid, fill the vertical longitudinal joint between Wythes solidly and with mortar for the following masonry work:

    1. Non-loadbearing interior walls or partitions where metal ties or horizontal reinforcing are required for structural bonding and nominal thickness of wall or partition is required to meet code requirements for height-to-thickness ratio.

ANCHORING MASONRY WORK

A. General: Provide anchor devices of types indicated and required.

B. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

    1. Anchor masonry to structural concrete members with metal ties (cast into concrete) embedded in masonry joints.

    2. Space ties as required, but not more than 600 mm vertically and 1000mm horizontally.

LINTELS

A. Install steel lintels where indicated.

B. Provide cast in place reinforced concrete lintels, minimum 200mm deep x full width of wall. Temporarily support lintels.

C. Provide minimum lintel bearing of 200 mm at each jamb, unless otherwise indicated.

CHAPTER FIVE
METAL WORKS

CHAPTER FIVE
METAL WORKS

5.1 METAL FABRICATIONS

PART 1 - GENERAL

SUMMARY

A. Definition: Metal fabrications includes components and assemblies from ferrous and non-ferrous metal shapes, plates, bars, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems specified elsewhere.

B. Extent of metal fabrications is indicated on drawings, and includes but is not necessarily limited to the following:

1. Ladders
2. Parking, brick tile support and all accessories
3. Fences, gates, roof, etc…

PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit, by accurate field measurements before fabrications; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

MATERIALS

A. Ferrous Metals

1. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes and including pitting, seam marks, roller marks, rolled trade names and roughness.

2. Steel Plates, Shapes and Bars: ASTM A 36 or BS 1449.

3. Rolled Steel floor plates: ASTM A 786.

4. Steel Tubing: Cold formed, ASTM A 500; or hot-rolled, ASTM A 501, BS 4848, or BS 2994.

5. Structural Steel Sheet: Hot-rolled, ASTM A 570; or cold-rolled ASTM A 611, of grade required for design loading.

6. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

B. Aluminum

1. All aluminum works should be as manufactured by Sidem Type Deluxe.

C. Grout

1. Non-Shrink Non-Metallic Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified and required.

D. Fasteners

1. General: Provide stainless steel fasteners for exterior use or where built into exterior walls. Select fasteners for the type, grade and class required.

2. Bolts and Nuts: Regular-hexagon head type.

   Lag Bolts: Square head type.

   Machine Screws: Cadmium plated steel.

   Wood Screws: Flat head carbon steel.

Plain Washers: Round, carbon steel.

Anchorage Devices: Drilled in expansion anchor bolts.

Toggle Bolts: Tumble-wing type, class and style as required.

Lock Washers: Helical spring type carbon steel.

E. Paint

1. Shop Primer for Ferrous Metal: Manufacturer's or fabricator's standard, fast-curing, lead-free, "Epoxy" primer; selected for good resistance to aggressive atmospheric corrosion, for compatibility with finish paint systems indicated and for capability to provide a sound foundation for field applied topcoats despite prolonged exposure.

2. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel.

3. Bituminous Paint: Cold applied asphaltic mastic.

4. Zinc Chromate Primer.

F. STAINLESS STEEL

Where stainless steel is specified it shall be what is known to the trade as Austentic 18-8, type 316, with a content of from 17% to 19% chrome, 7% to 9% nickel and a maximum, carbon content of 0.11%.

Stainless steel shall be free from scale and all surfaces shall be polished to a No.4 commercial finish where specified.

PART 3 - EXECUTION

PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

INSTALLATION

A. General:

1. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

2. Cutting, Fitting and Placement: Perform cutting drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plus, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.

3. Fit exposed connections accurately together to form tight hairline joints. Weld connections, which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units, which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

4. Field welding: Comply with relevant codes for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

5. Corrosion Protection: Coat concealed surfaces of Aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint or zinc chromate primer.

ADJUST AND CLEAN

1. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

2. For galvanized surfaces: Clean field welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780, or BS 729.

CHAPTER SIX
WOOD WORKS

CHAPTER SIX
WOOD WORKS

6.1 JOINERY

PART 1 - GENERAL

SUMMARY

A. Types of joinery and architectural woodwork included in this Section include the following:

1. Wood casework.
2. Plastic laminate clad casework.
3. Countertops, including stonework counter tops.
4. Hardware, ironmongery, accessories and miscellaneous trim incorporated into joinery in accordance with Drawings.

B. "Rough Carpentry" for grounds, blocking, framing, furring, and other carpentry work that is not exposed to view is specified elsewhere.

C. Wood Doors are specified elsewhere.

QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm experienced in successfully producing joinery and architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standard" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

C. Hardware Coordination: Distribute copies of approved schedule for cabinet hardware to manufacturer of joinery and architectural woodwork; coordinate cabinet shop drawings and fabrication with hardware requirements.

D. Except for stonework, proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude products of other manufacturers.

PART 2 - PRODUCTS

MATERIALS

A. General: Provide materials of premier quality grades that comply with requirements of the relevant woodworking standard for each type of woodwork and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

1. Hardboard.

2. Plastic Laminate Facing: BS 3794, Class 1, 1.5 mm thick.

3. Plywood: BS 1455 ; WBP bonding; Grade 1 where polished / varnished.

4. Blockboard (Latte): BS 3444 ; WBP bonding.

5. Face Veneers: Hard, durable and capable being finished to a smooth surface; free from knots, holes splits, stains, filling or any other defects.

6. Adhesives for Face Veneers: BS 1203.

WOOD TYPES

A. General: Provide first quality premier grade wood types where indicated on Drawings and as specified herein.

1. Softwood: Douglas Fir, Longleaf Pine, European Redwood, or other equal approved.

2. Pine: (where shown on Drawings) South American Parana Pine.

3. Hardwoods and Veneers:

   a. Generally: Canadian Yellow Birch, Meranti, Zan, or other equal approved.
   b. Teak: Burmese teak.
   c. Mahogany: Honduran mahogany.

PART 3 - EXECUTION

INSTALLATION GENERALLY

A. Quality Standard: Install woodwork to meet or exceed AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.

B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 6.25 mm in 2400 mm for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. Casework and Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated and required. Maintain veneer sequence matching (if any) of cabinets with transparent finish.

F. Tops: Anchor securely to base units and other support systems as indicated.

G. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

ADJUSTMENT AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semi exposed surfaces. Touch up factory applied finishes to restore damaged or soiled areas.

PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to the Engineer that ensures that woodwork is undamaged at time of Taking-Over.

6.1.1 CABINETWORK
(Showcase and Counter)

6.1.1.1 GENERAL

A. Description:

1. Furnish all labor, materials, tools, equipment, and services necessary for architectural cabinetwork, in accord with provisions of Contract Documents.
2. Completely coordinate with work of other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

B. See drawings for types of countertops required.

C. Submittals:

1. Shop drawings:
   a) Complete details of construction and elevations of all cabinets.

2. Product data:
   b) Wall cabinet load test reports.

3. Samples:
   c) Each finish for pattern, finish and color selection.

D Conditions:

1. Verify dimensions at site.

2. Verify locations of items related to cabinetwork but specified in other sections.

3. If necessary to vary from arrangement indicated because of structural, mechanical, electrical or other considerations, make such variations only after approval of Architect.

6.1.1.2 PRODUCTS

A. General

A.1 Cabinetwork: Custom, shop- or factory-built casework, complete with all hardware, accessories, countertops and bases glass face, in sizes and configurations indicated.

1. Style: Flush overlay, with square cornered doors and drawer fronts overlapping case front with minimum reveal.

B. Hardware

B.1 Hardware for hinged doors:

1. Hinges as per the Engineer instruction.

2. Catch: Magnetic, adjustable, 2.7 to 3.2 KG (6-7 LB) pull, provide 2 on each door over 0.37 SM (4 SF), provide 1 on each door 0.37 SM (4 SF) and smaller.

B.2 Hardware for drawers:

1. Slides: Zinc-plated cold-rolled steel, side slides, 45 KG (100 LB) capacity, nylon wheels/rollers, stainless steel ball bearings, positive closing and pull-out stops, drawer removable without use of tools, file drawers: Full extension. Required clearance 19 mm (3/4 IN).

2. Pull: Wire, 7.9 mm (5/16 IN) diameter x 33.3 mm (1 5/16 IN) projection x 100 mm (4 IN) centers, satin chrome finish. Provide 2 on drawers over 457 mm (18 IN) wide.

B.3 Shelf supports (drilled hole type):

1. Holes drilled at 25 to 50 mm (1 to 2 IN) OC.

2. Shelf clips: Nylon, ABS plastic, or steel, designed to engage securely in holes.

B.4 Shelf supports (recessed standard type):

1. Standards: Aluminum or zinc-coated or plated steel, slotted at 25 to 50 mm (1 to 2 IN) OC, for recessed installation.

2. Shelf clips: Plated or zinc-coated steel, designed to engage securely in slots.

C. Fabrication-Case Components-Plastic Faced

C.1 Case body members (except backs not exposed): 18 mm (3/4 IN) minimum thick plywood.

1. Base unit top: Use either full sub-top or web frame.
2. Web frames: Lumber.
3. Provide drawer lock rails at all drawers.
4. Provide backs on all cabinets.

C.2 Unexposed case back: 6 mm (1/4 IN) minimum thick hardboard or plywood.

C.3 Shelves: 18 mm (3/4 IN) minimum thick plywood, 25 mm (1 IN) thick over 91 mm (36 IN) between supports or 20mm glass shelves as per the Engineer instruction.

C.4 Doors: Plywood.

1. Up to 650 mm (26 IN) wide or 1220 mm (48 IN) high: 18 mm (3/4 IN) thick.
2. Up to 900 mm (36 IN) wide or 1680 mm (66 IN) high: 30 mm (1 1/4 IN) thick.
3. Over 900 mm (36 IN) wide or 1680 mm (66 IN) high: 35 mm (1 3/8 IN) thick, solid-core.

C.5 Drawers:

1. Fronts: 18 mm (3/4 IN) thick Plywood.
2. Sub-front (if used) sides and backs: 12 mm (1/2 IN) thick hardwood.
3. Bottom: 6 mm (1/4 IN) thick, minimum, hardboard, over 45 mm (18 IN) wide provide intermediate reinforcing rails.

C.6 Case base: Separate or integral.

C.7 Small compartment dividers and dust panels: 6 mm (1/4 IN) thick hardboard.

C.8 Filler panels and scribe pieces: Plywood, provide as required to fit standard size units to space.

C.9 Plastic laminate countertops: 18 mm (3/4 IN) thick Plywood, built up to 31 mm (1-1/4 IN) at all edges. Backsplash 102 mm high.

C.10 Finishes:

1. All exposed surfaces: Plastic laminat (1.5mm Thick).
2. All semi-exposed surfaces not covered with plastic laminate backer sheet (except hardwood): Plastic overlay. (1.5mm Thick)
3. Edges of doors, drawer fronts and case body members: Hardwood strips as shown on Drawings.

C.11 Finishing hardwood:

1. Set all nails.
2. Fill holes.
3. Sand smooth.
4. Apply stain.
5. Sand after stain is dry.
6. Apply varnish in 3 coats.
7. Sand between coats.

6.2 HIGH PRESSURE LAMINATE (HPL)

6.2.1 GENERAL

Constructed from layers of high quality kraft paper, reinforced by thermosetting resins under high pressure and temperature with one decorative surface. The result is a hygienic 0.8 mm thick flexible sheet material.

HPL is bonded onto a high density coreboard to produce a strong finished panel. Panels can be post-formed to create a seamless, curved edge detail.

HPL is suitable for use in areas of high traffic and reasonably demanding conditions.

6.2.2 PANEL CUBICLES

A. SCOPE OF SECTION

This section deals with proprietary panel cubicles assembled on site from factory finished kits of parts including, panels, doors, privacy screens, framing, stiffening, connecting and fixing devices, door ironmongery, coat hooks, toilet roll holders, bench and other accessories.

B. PANEL CUBICLES GENERALLY

- Manufacturer: Refer to appendix A.
  - Product reference: To the Engineer's selection.
- Panels:
  - Height (overall): As indicated on the contract drawings.
  - Floor clearance: As indicated on the contract drawings.
  - Core material: High pressure solid compact laminate.
  - Thickness: 12 mm.
  - Facings: To the Engineer's selection from the manufacturer's standard range.
  - Colour/ Pattern/ Species: To the Engineer's selection from the manufacturer's standard range.
  - Edge treatment: Chamfered and finished without trim.
  - Wall support: Aluminum satin anodized pedestals/shoes on the floor and aluminum satin anodized angles on the walls.
- Pilasters:
  - Core material: High pressure solid compact laminate.
  - Thickness: 12 mm.
  - Facings: To the Engineer's selection from the manufacturer's standard range.
  - Colour/ Pattern/ Species: To the Engineer's selection from the manufacturer's standard range.
  - Edge treatment: Chamfered and finished without trim.

- Doors:
  - Height: As indicated on the contract drawings.
  - Core material: High pressure solid compact laminate.
  - Thickness: 12 mm.
  - Facings: To the Engineer's selection from the manufacturer's standard range.
  - Colour/ Pattern/ Species: To the Engineer's selection from the manufacturer's standard range.
  - Edge treatment: Chamfered and finished without trim.
  - Ironmongery: Aluminum satin anodized.
  - Colour: To the Engineer's selection from the manufacturer's standard range.
- Fittings:
  - Headrails: Aluminum satin anodized.
  - Pedestals/ Shoes: Aluminum satin anodized.
- Accessories: Aluminum Satin Anodized.
- Other requirements: All accessories to be of bacteria resistant Aluminum satin.

C. SAMPLES

- General: Before placing orders submit representative samples of the following:
  - Panel material and complete colour chart.
  - All ironmongery/ accessories.
- Delivered materials/ products: To match samples.

D. CONTROL SAMPLES

- General: Complete samples as part of finished work and obtain approval of appearance before proceeding.
- Types: All items specified in this section and applicable to the project.
  - Locations: As agreed with the Engineer.

E. INSTALLATION

- Programming: Do not install cubicles or duct/ wall panels before building is weathertight, wet trades have finished their work, wall and floor finishes are complete, and the building is well dried out.
- Accuracy: Set out to ensure frames and/ or panels and doors are plumb, level and accurately aligned.
- Modifications: Do not cut, plane or sand prefinished components except where shown on drawings.
- Fixing: Secure components using methods and fasteners recommended by the cubicle/ panel manufacturer. Prevent pulling away, bowing or other distortions to frames, panels and doors.
- Moisture and thermal movement: Make adequate allowance for future movement.

6.2.3 FABRICATION: ANODIZED ALUMINUM ACCESSORIES FOR TOILET PARTITIONS

Aluminum alloys are anodized to increase corrosion resistance and to allow dyeing (coloring), improved lubrication, or improved adhesion. However, anodizing does not increase the strength of the aluminum object. The anodic layer is non-conductive.

Aluminum alloy parts are anodized to greatly increase the thickness of this layer for corrosion resistance. The corrosion resistance of aluminum alloys is significant decreased by certain alloying elements or impurities: copper, iron, and silicon.

Although anodizing produces a very regular and uniform coating, microscopic fissures in the coating can lead to corrosion. To combat this, various techniques have been developed either to reduce the number of fissures or to insert more chemically stable compounds into the oxide, or both.

Anodized coatings have a much lower thermal conductivity and coefficient of linear expansion than aluminum.

6.3 TIMBER LOGS CLADDING

6.3.1 GENERAL

Constructed from pine trees or any other trees that should not affect the environment.

The logs should be well treated or creosoted and imported from a reliable source.

All logs should be horizontally in shape cleaned and painted with lacquer for protection or any suitable part transparent covers and approved by the Engineer.

CHAPTER SEVEN
BITUMINOUS

7.11 BITUMINOUS EMULSION COATING

PART 1 - GENERAL

1. SUMMARY

   A. Extent of Bituminous Emulsion Coating Cold Applied work is shown on Drawings.

   B. Architectural plaster layer is specified elsewhere.

      1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

      2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected or stainless steel protected.

   C. Section Includes cold-applied emulsified asphalt damp proofing.

PART 2 - PRODUCT

A. Bituminous emulsion paint is a multi-use, non-toxic, non-flammable, salt-resistant, cold-applied material used in waterproofing external and internal surfaces above and below ground level. The coating has many advantages that includes strong adhesion, tensile strength, its suitability on new surfaces and refurbished structures, and can be used in humid conditions. The material is water-based, and non-hazardous to environment, yet it is highly recommended to take precaution by wearing protective equipment when applying.

   Given the proper time, bituminous emulsion dries into a damp proof rubber film that has the capability of undergoing and resisting certain amount of movements, compressive and tensile stresses, as well as resisting extreme temperatures, water vapor and water.

   Bituminous emulsion coating can be applied on foundations, on concrete and steel surfaces in order to resist the water and salt content below ground. The coating should not be exposed directly to sunlight, since the material is non-resistant to ultraviolet radiation.

Bituminous emulsion coating can be applied on newly casted concrete. Consumption rate depends on the nature of the surface (porosity), the density (water proportion), and the thickness of the coating.

PART 3 - EXECUTION

1. APPLICATION OF COATING

A. Bituminous emulsion coating may be applied on sub terrain concrete structures that should be above the water table level. Coating may also be applied on roof structures, wall structures, that include hollow blocks, plaster and other exposed concrete structures before setting up claddings.

All acquired drums and pails must be safely stored from heat, sunlight, ultraviolet, and theft. Storage of more than 12 months may result in deterioration of the contents.

The coverage / consumption rate depends on the nature of the surface and the thickness required.

Before applying the coating, all surfaces must be cleaned, cleared, smoothened, sanded and should avoid all sorts of defects such as gaps, cavities, bumps and loose mass.

All defects must be treated and cured in the necessary procedure before applying the emulsion paint: filling cavities, and the removal of excessive material and fragments from surface to ensure a smooth finish.

Finally, the removal of stains, grease and any other undesired substance, that is probably the result of site work to guarantee a better bond between the surface and emulsion coating.

The liquid must be mixed well to achieve a better quality and to avoid any sediment.
Bituminous emulsion paint may be stroked using typical brush, roller, airless spray or squeegee. The material must be brushed several times to ensure that all recesses, edges, gaps, joints, intersections and all cavities have been covered. Stroking overlaps are necessary during the application to obtain an integrated uniform result.

When applying bituminous emulsion paint, coating thickness and application rate must be taken into consideration while following the manufacturers' directions. Before applying bituminous emulsion coating, surfaces must strictly be dust-free. Dry surfaces are then dampened so it may act as a primer and as an adhesion. When dampened, it is recommended to apply bandages to corners.

Apply the bituminous emulsion coating mainly as advised by manufacturers' directions, and also keeping in mind the necessary atmospheric conditions during application.

During application, temperatures should not deceed 5°C and not exceed 55°C.

The applied and finished bituminous emulsion paint must be protected from site work activities and anything that may cause it damage.

Health and safety:

Labors and workers must protect themselves from bituminous emulsion coating by wearing gloves, eye protection and long sleeves for skin protection.

The contractor is to follow and conform with the instructions of the site engineer.

2. GENERAL APPLICATION

A. Comply with manufacturer's written instructions for substrate preparation, damp proofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
   i. Apply damp proofing to provide continuous plane of protection.
   ii. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where damp proofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of (150 mm) over outside face of footing.
   i. Extend damp proofing (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

   ii. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of damp proofing. Damp proofing coat for embedding fabric is in addition to other coats required.

C. Where damp proofing exterior face of inner Wythe of exterior masonry cavity walls, lap damp proofing at least (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner Wythe.
   i. Extend damp proofing over outer face of structural members and concrete slabs that interrupt inner Wythe.
   ii. Lap damp proofing at least (6 mm) onto shelf angles supporting veneer.

D. Where damp proofing interior face of above-grade, exterior [concrete] [and] [masonry] [single-Wythe masonry] walls, continue damp proofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by damp proofing wall before constructing intersecting walls.

3. APPLICATION IN DETAIL

1. Concrete Foundations[and Parged Masonry Foundation Walls]: Apply two brush or spray coats at not less than (0.6 L/sq. m) for first coat and (0.4 L/sq. m) for second coat, one fibered brush or spray coat at not less than (1.2 L/sq. m), or one trowel coat at not less than (1.6 L/sq. m).
2. Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than (0.6 L/sq. m) for first coat and (0.4 L/sq. m) for second coat, primer and one fibered brush or spray coat at not less than (1.2 L/sq. m,) or primer and one trowel coat at not less than (2 L/sq. m).
3. Unexposed Face of Concrete Retaining Walls: Apply one brush or spray coat at not less than (0.5 L/sq. m).
4. Unexposed Face of Masonry Retaining Walls plastered exterior walls: Apply primer and one brush or spray coat at not less than. (0.5 L/sq. m).
5. Concrete Backup for [Brick Veneer Assemblies] [Stone Veneer Assemblies] [and] [Dimension Stone Cladding]: Apply one brush or spray coat at not less than (0.4 L/sq. m).
6. Masonry Backup for [Brick Veneer Assemblies] [Stone Veneer Assemblies] [and] [Dimension Stone Cladding]: Apply primer and one brush or spray coat at not less than (0.4 L/sq. m).
7. Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than (0.4 L/sq. m).
8. Interior Face of Exterior Concrete Walls: Where above grade and indicated to be furred and finished, apply one brush or spray coat at not less than (0.4 L/sq. m).
9. Interior Face of [Single-Wythe] Exterior Masonry Walls: Where above grade and indicated to be furred and finished, apply primer and one brush or spray coat at not less than. (0.4 L/sq. m).

4. INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured damp proofing. Comply with damp proofing-material and protection-course manufacturers' written instructions for attaching protection course.

5. COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

   a. APOC, Inc.; a division of Gardner-Gibson.
   b. BASF Construction Chemicals - Building Systems; Sonneborn Brand Products.
   c. Brewer Company (The).
   d. Chem Masters, Inc.
   e. Euclid Chemical Company (The); an RPM company.
   f. Grander-Gibson, Inc.
   g. Henry Company.
   h. Karnak Corporation.
   i. Koppers Inc.
   j. Malarkey Roofing Products.
   k. Meadows, W. R., Inc.

B. Low-Emitting Materials: Damp proofing shall comply with the testing and product requirements of the Libnor Standard.

C. Auxiliary Materials

   1. General: Furnish auxiliary materials recommended in writing by damp proofing manufacturer for intended use and compatible with bituminous damp proofing
   2. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
   3. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

CHAPTER EIGHT
DOORS AND WINDOWS

CHAPTER EIGHT
DOORS AND WINDOWS

8.1 - METAL DOOR AND FRAMES

PART 1 - GENERAL

8.1.1 DESCRIPTION

A. General

1. Furnish all labor, materials, tools, equipment, and services for metal doors and frame, in accord with provisions of Contract Documents.
2. Completely coordinate with work of other trades.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.
4. See Division 1 for General Requirements.

B. Related work specified elsewhere:

1. Finish hardware: Section 8.5.
2. Wood doors: Section 8.2.
3. Glass and glazing: Section 8.4.

8.1.1.2 Submittals

A. Product Data:
1. Manufacturer's technical information including specifications and catalog cuts for all products specified herein.

B. Shop Drawings:
1. Show details of each frame type and elevations of each door type. Show conditions at openings and details of construction.
2. Show gages, location of reinforcements, anchorage and accessory items.
3. Submit schedule of doors and frames. Use same scheduling system as that shown in the Door Schedule.

PART 2 - PRODUCTS

8.1.2 MATERIALS - GENERAL

A. Steel sheet and strip: Commercial quality carbon steel, ASTM A568.

B. Galvanized steel sheets: ASTM A525, G90 coating, phosphatized.

C. Supports and anchors: Not less than 1.5 mm (16 ga) sheet steel. Galvanize items to be built into exterior walls after fabrication, ASTM A153, Class B.

D. Inserts, bolts and fasteners: Manufacturer's standard units. Galvanize items to be built into exterior walls ASTM A153, Class C or D as applicable.

E. Primer: Suitable for Galvanized metal sheets enamel or paint, air-drying or baked, suitable as base for specified finish paints**.**

F. Galvanized repair paint: Mil. Spec. DOD-P-21035.

G. Lead sheet: ASTM B29, free from imperfection affecting performance, thickness as indicated.

8.1.2.1 Doors and Frames

A. Doors, Timber or Melamine.

B. Vision panels:
   1. Fixed, integral stops on exterior face, screwless snap-in stops or stops secured with countersunk Phillips head machine screws on interior face.
   2. Glass: Section 8.4.

C. Frames, Timber or Melamine, types as indicated.
   1. Split-type frames are not acceptable.
   2. Conceal all fastenings.
   3. All joints: Tightly butted and fully welded.
   4. All frames should be painted from the back & bottom 15 cm with asphalt.

8.1.2.2 FABRICATION

A. General:
   1. Fabricate rigid, neat in appearance and free from defects.
   2. Form to indicated sizes and profiles.
   3. Fit and assemble in shop, where practical.
   4. Mark work that cannot be fully assembled in shop, to assure proper assembly at site.

B. Prepare for finish hardware, in accord with hardware schedule, templates provided by hardware supplier, and ANSI A115 series "Specifications for Door and Frame Preparation ".
   1. Locate finish hardware in accord with SDI 100.
   2. Locate patient latches in accord with manufacturer's recommendations.

C. Clean off mill scale and foreign materials, touch-up damaged steel and galvanized surfaces.

D. Shop prime.

PART 3 - EXECUTION

8.1.3.1 INSPECTION

A. Examine structure, substrates, and conditions under which work in to be installed for conditions detrimental to correct and timely completion.

B. Installation constitutes acceptance of responsibility for performance.

8.1.3.2 INSTALLATION

A. Place frames prior to construction of enclosing walls and ceilings.

B. Separate structural lintels are to be installed over all doorframes in masonry. Do not use doorframes as lintels to carry masonry.

C. Plumb, align, and brace securely until permanently anchored.

D. After completion of walls, remove temporary braces and spreaders.

E. Install minimum of 3 anchors of type appropriate to wall construction per jamb. Minimum acceptable anchors: 1.5 mm (16 ga), 25 mm (1 IN) wide corrugated steel.

F. Provide removable spreaders at bottom of frame.

G. Coordinate building-in of anchors and frame grouting with other trades.

H. Grout all frames.

I. Leave work complete and in proper operating condition.

G. Remove defective work and provide new acceptable products.

8.2 WOOD DOORS

PART 1 - GENERAL

DESCRIPTION OF WORK

A. Extent and location of each type of wood door is shown on Drawings and in schedules.

B. Types of doors required include the following

1. Massive Flush wood doors or panels.

C. Shop finishing of wood doors is included in this section.

D. Factory-preparation for door hardware (pre-machining) for wood doors, melamine doors and partitions is included in this section.

E. The following related work is specified elsewhere:

1. Door hardware installation.
2. Painting.

APPLICABLE CODES AND STANDARDS

ANSI/NWMA	I.S.I Industry standards for wood flush doors.
AWI	Quality Standard; Section 1300. Architectural woodwork quality standards.
BS 1186	Quality of timber and workmanship.
BS 4787: part 1	Dimensions of wood doorsets.
BS 5359	Methods of testing doors.

PART 2 - PRODUCTS

MATERIALS AND COMPONENTS - GENERAL

A. General: Provide wood doors, wood windows, showcase panels complying with applicable requirements for kinds and types of doors indicated on drawings and as scheduled and specified.

B. Face Panels: wood panelling.

GENERAL FABRICATION REQUIREMENT

A. Transom and Side Panels: Wherever transom panels or side panels of wood are shown in same framing systems as wood doors, provide panels which match quality and appearance of associated wood doors, unless otherwise indicated. Fabricate matching panels with same construction, exposed surfaces and finish as specified for associated doors or by adding a picture on each door.

SOLID DOORS: LACQUER FINISH

A. Typical Standard Doors:

1. Facing: Lacquer finish.
2. Core: Precision planed hardwood board, butt-jointed and glued edge to edge to form a solid laminated construction with the entire MDF as shown on drawings.
3. Edge: exposed hardwood framed stiles, top and bottom rails; tongued and grooved to core.

ADHESIVE

A. Adhesive for all interior doors shall be of MR grade.

SHOP FINISH

A. Prefinish wood doors requiring transparent finish at factory or finish shop.

B. Doors requiring paint finish shall be sandpapered smooth, filled and primed at factory, ready for site painting.

C. Comply with recommendations of Applicable Codes and Standards for factory finishing of doors, including final sanding immediately before application of finishing materials.

1. Provide finishes of type indicated or agreed with the Engineer, to match samples held by the Engineer.

PRE-FITTING AND PREPARATION FOR HARDWARE

A. Pre-machine wood doors at factory.

B. Machine doors for hardware requiring cutting of doors.

PART 3 - EXECUTION

INSPECTION

A. Examine door frames and verify that frames are correct size and type and have been installed as required for proper hanging of corresponding doors. Do not proceed with installation until unsatisfactory conditions have been corrected.

INSTALLATION

A. Condition doors to average prevailing humidity in installation area prior to hanging.

B. Hardware: For installation refer to Door Hardware (Ironmongery) section of these specifications.

C. Manufacturer's Instructions: Install wood doors in accordance with manufacturer's instructions and as indicated and required.

D. Shop-Finished Doors: Restore finish on edges of shop finished doors before installation, if fitting or machining is required at the job site.

ADJUST AND CLEAN

A. Final Check:

1. Replace doors damaged during installation or which are warped, bowed or otherwise unacceptable.
2. Rehang or replace doors, which do not swing freely or operate smoothly and satisfactorily.

B. Protection: Provide protection and maintain conditions in a manner acceptable to the Engineer that will ensure doors and door hardware, are undamaged at time of Taking Over.

8.3 ALUMINUM DOORS AND WINDOWS

PART 1 - GENERAL

SUMMARY

A. Extent of aluminum doors and windows is indicated on Drawings and schedules.

B. Types required for the project include:

1. Glazed aluminum windows.

C. Glass and glazing is specified elsewhere.

D. Lock cylinders are specified in the Door Hardware (Ironmongery) of the specification. Cost is included within the cost of each item.

SYSTEM DESCRIPTION

A. Performance Requirements: Provide aluminum assemblies that have been designed and fabricated to comply with the following specified performance characteristics. Compliance may be demonstrated by testing manufacturer's corresponding stock systems according to methods indicated.

B. Wind Loading: Provide assemblies capable of withstanding a uniform test pressure of 0.96 kPa (20 psf) inward and 0.96 kPa (20psf) outward when tested in accordance with ASTM E 330.

C. Exterior Windows (and internal windows where applicable): Except as otherwise indicated, comply with air infiltration tests, water resistance tests, and applicable load tests, specified in ANSI/AAMA 302.9 for type and classification of window units required in each case; or, comply with applicable British Standards, i.e. BS 4873, 4315, Part 1.

SUBMITTALS

A. Product Data: Submit manufacturer's product specifications, technical data, standard details, and installation recommendations for each type of product required. Include the following information:

1. Fabrication methods.
2. Finishing.
3. Hardware.
4. Accessories.

B. Shop Drawings: submit shop drawings for fabrication and installation of Aluminum doors and windows, including the followings:

1. Elevations.
2. Details section of typical composite members.
3. Hardware, mounting heights.
4. Anchorages and reinforcements.
5. Expansion provisions.
6. Glazing details.

QUALITY ASSURANCE

A. Manufacturer's Qualifications: Unless otherwise acceptable to the Engineer provide doors and windows produced by a single manufacturer with not less than 5 years successful experience in the fabrication of assemblies of the type and quality required.

B. Design Criteria: Drawings indicate sizes, spacing of members, profiles and dimensional requirements of doors and windows. Minor deviations will be accepted in order to utilize manufacturer's standard products when, in the Engineer's sole judgment; such deviations do not materially detract from the design concept or intended performances.

PROJECT CONDITIONS

A. Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

PART 2 - PRODUCTS

MANUFACTURERS

A. Available Manufacturers: subject to compliance with requirements, manufacturers offering products which may be incorporated in the work of a good factory.

MATERIALS

A. Aluminum Members: Provide alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221; BS 1474 for extrusions and ASTM B 209; BS 1470 for sheet or plate.

B. Fasteners: Provide fasteners of Aluminum or non-magnetic stainless steel (316) and fully compatible with Aluminum components, hardware, anchors and other components.

1. Reinforcement: Where fasteners screw-anchor into Aluminum less than 3mm thick, reinforce the interior with Aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non corrosive pressed-in splined grommet nuts.

2. Exposed Fasteners: Use of exposed fasteners will not be acceptable unless specifically approved by the Engineer. For the application of hardware and subject to approval by the Engineer, use fasteners that match the finish of member or hardware being fastened.

a. Provide Phillips flat-head machine screws for exposed fasteners.

C. Brackets and Reinforcements: Where feasible, provide high- strength aluminum brackets and reinforcements; otherwise provide non-magnetic stainless steel or hot-dip galvanized steel complying with ASTM A 386; BS 729.

D. Concrete/Masonry Inserts: Provide concrete and masonry inserts fabricated from cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386; BS 729.

E. Compression Weather-stripping: Provide the manufacturer's standard replaceable compressible weather-stripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.

F. Sliding Weather-stripping: Provide the manufacturer's standard replaceable weather-stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.

G. Glass and Glazing Materials: Comply with requirements of Glass and Glazing section of the specifications.

COMPONENTS

A. Aluminum Door, Window and Louver Frames: Fabricate from manufacturer's standard tubular and channel frame assemblies, with welded or mechanical joints in accordance with manufacturer's standards; reinforce as necessary to support required loads. Provide and incorporate all Aluminum components, accessories, and anchorages as indicated and required.

1. Design: Provide doors and windows of thickness and design indicated.

2. Glazing: Fabricate doors and windows to facilitate replacement of glass or panels, without disassembly of frames. Provide snap-on extruded aluminum glazing stops, with exterior stops anchored for non-removal, or heat-resisting PVC glazing sections of a type approved by the Engineer.

B. Glass: Provide manufacturer's standard glass of the type and thickness indicated on drawings, or otherwise approved by the Engineer.

HARDWARE

A. General: Refer to Door Hardware section of the specification for hardware items other than those indicated to be provided by the aluminum entrance manufacturer.

B. Provide manufacturer's heavy-duty hardware units as indicated, scheduled, or required for operation of each door, of sizes, number, and type recommended by manufacturer and approved by the Engineer, for service required, finished to match door.

1. Keyed Cylinders: Provide mortise type, 5-pin tumbler, outside cylinder units with cast aluminum face;

    a. co-ordinate and comply with master keying requirements specified in Door Hardware section of the specification.

2. Exterior Entrance Thresholds: Provide extruded aluminum threshold or size and design indicated in mill finish, complete with anchors and clips, coordinated with pivots and floor-concealed closers.

FABRICATION

A. General: Sizes of door, frame and window units, and profile requirements. are indicated on drawings. Variable dimensions are indicated, with maximum and minimum dimensions required to achieve design requirements and coordination with other work.

B. Prefabrication: Before shipment to the project site, complete fabrication, assembly, finishing, hardware application, and other work to the greatest extent possible. Disassemble components only as necessary for shipment and installation.

1. Preglaze door, and window units to greatest extent possible.
2. Do not drill and tap for surface-mounted hardware items until time of installation at project site.
3. Perform fabrication operations, including cutting, fitting, forming, drilling and grinding of metal work to prevent damage to exposed finish surfaces. For hardware, perform these operations prior to application of finishes.

C. Welding: Grind exposed welds smooth and restore mechanical finish.

D. Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.

E. Dissimilar Metals: Separate dissimilar metals with bituminous paint, or other separator that will prevent corrosion.

F. Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

1. Uniformity of Finish: Abutting extruded aluminum members shall not have an integral color or texture variation greater than half the range indicated in the sample pair submittal.

G. Fasteners: Conceal fasteners.

H. Weather-stripping: For exterior doors and windows, provide compression weather-stripping against fixed stops; at other edges, provide sliding weather-stripping retained in adjustable strip mortised into door or window edge.

FINISHES

A. General: Refer to drawings/schedules for type of finish required.

PART 3 - EXECUTION

INSTALLATION

A. Comply with manufacturer's instructions and recommendations for installation.

ADJUSTING

A. Adjust operating hardware to function properly, for smooth operation without binding, and for weather tight closure.

CLEANING

A. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

B. Clean glass surfaces after installation. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum doors, screens and windows will be without damage or deterioration, other than normal weathering, at time of Taking-Over.

8.4 GLASS AND GLAZING

PART I - GENERAL

SUMMARY

A. Extent of glass and glazing work is indicated on Drawings and schedules.

B. Work in this section include glass and glazing for:

1. Aluminum windows.

C. Mirror glass units are specified elsewhere.

SYSTEM DESCRIPTION

A. Provide glass and glazing that has been produced, fabricated and installed to withstand normal thermal movement, wind loading and impact loading (where applicable), without failure including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glass and glazing materials and other defects in the work.

QUALITY ASSURANCE

A. Glass and Glazing Standards: Conform and comply with relevant ASTM, ANSI, BS or alternative equivalent codes and standards acceptable to the Engineer which establish minimum qualitative and quantitative requirements for glass and glazing products and methods of installation for the types indicated and required.

B. Where the following products are indicated or required, provide glass which complies with relevant testing requirements of specific standards, and which are labeled and listed as such by a testing and inspection agency acceptable to the Engineer.

1. Safety glass.
2. Fire resistance rated wire glass.

C. Single Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer for each and condition of glass and glazing indicated or required.

PART 2 - PRODUCTS

GLASS PRODUCTS, GENERAL

A. Primary Glass Standard: Provide primary glass which complies with specific referenced standard requirements, including those indicated by reference to type, class, quality, and, if applicable, form, finish, mesh and pattern.

B. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.

PRIMARY GLASS PRODUCTS

A. Clear Float Glass: Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), to FS DD-G-451 or BS 952: Section I: Part 3.

GLAZING SEALANTS, TAPES AND GASKETS

A. General: Provide manufacturer's standard products of types indicated or required and complying with specific referenced standards and the following requirements:

1. Compatibility: Select glazing sealants, tapes and gaskets of proven compatibility with other materials with which they will come into contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

2. Suitability: Comply with recommendations of sealant and glass manufacturers for selection of glazing sealants, tapes and gaskets which have performance characteristics suitable for applications indicated and conditions at time of installation.

3. Colors: Provide color of exposed sealants indicated or, if not otherwise indicated, as selected by Engineer from manufacturer's standard colors.

MISCELLANEOUS GLAZING MATERIALS

A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealants, 80 to 90 Shore A durometer hardness.

D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing sealant, of size, shape and hardness recommended by glass and sealant manufacturers for application indicated.

E. Edge Blocks: Neoprene, EPDM or silicone blocks as required for compatibility with glazing sealant, of size and hardness required to limit lateral movement (side-walking) of glass.

F. Compressible Filler Rods: Closed-cell or waterproof jacketed rod stock of synthetic rubber or plastic foam, flexible and resilient, with 35-69 kPa compression strength for 25 percent deflection.

PART 3 - EXECUTION

EXAMINATION

A. Inspect work of glass framing assembling for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners; for presence and functioning of weep system; for existence of minimum required face or edge clearances; and for effective sealing of joinery. Do not allow glazing work to proceed until unsatisfactory conditions have been corrected.

PREPARATION

A. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings, which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

8.5 DOOR HARDWARE (IRONMONGERY)

PART 1 - GENERAL

DESCRIPTION OF WORK

Section includes: Hardware for steel & Wooden Doors.

STANDARDS

A. All hardware should be of the first class category as manufactured by UNION.

SUBMITTALS

A. Product Data: Include installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. Details of electrified door hardware. Include location, sequence of operation, and interface with other building control systems.

2. Indicate type, locations and mounting heights of each type of hardware as scheduled, catalogue cuts, electrical characteristics and connection requirements.

3. Submit manufacturers parts, lists and templates.

C. Samples for Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of door hardware indicated.

D. Samples for Approval: For exposed door hardware, representative of each type required, in specified or selected finish, full size. Tag with identification for coordination with the Door Hardware Schedule.

1. Submit samples before submission of the Door Hardware Schedule.

E. Door Hardware Schedule: Prepared by or under the supervision of door hardware supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.

F. Keying Schedule: Prepared by or under the supervision of door hardware supplier, detailing final keying instructions for locks. Include keying diagram and index each key set to unique door designations.

G. Manufacturers Installation Instruction: Submit special procedure, perimeter conditions, requiring special information.

QUALITY ASSURANCE

A. Source Limitations: Obtain all door hardware from a single manufacturer or supplier, unless otherwise indicated.

PART 2 - PRODUCTS

MATERIALS AND FABRICATION - GENERAL

A. Hand of door: The Drawings show the direction of slide, swing or hand of each door leaf. Provide each item of hardware for proper installation and operation of the door swing as shown.

B. Manufacturer's Name Plate: Do not use products which have manufacturer's name or trade name displayed in a visible location.

C. Products : Provide manufacturer's standard catalogue products, conforming to templates, and generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws.

D. Provide screws for installation with each hardware item. Provide Phillips flathead screws except as otherwise required or approved by the Engineer. Finish exposed (exposed under any condition) screws to match the hardware finish or, if exposed in surfaces of other work, to match the finish of such other work as closely as possible.

E. Concealed Fasteners: Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard units of the type specified are available with concealed fasteners. Do not use through bolts for installation where the bolt head or the nut on the opposite face is exposed in other work .

F. Tools for Maintenance: Furnish two complete sets of any specialized tools as needed for Employer's continued adjustment, maintenance, and removal and replacement of hardware.

G. HARDWARE FINISHES

1. General: Exposed surfaces of hardware shall have manufacturer's standard satin anodized or stainless steel finish as indicated by the components listed in the Door Hardware Schedule.

COMPONENTS

A. GENERAL HARDWARE REQUIREMENTS

Where not specifically indicated, comply with applicable BS standards for each type of hardware required. Provide each type of hardware with accessories as required for the applications indicated and for complete, finished operational door.

1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently to avoid delay in work.
2. Reinforcement Units: Furnished by door and frame manufacturers; coordinated by hardware supplier.
3. Fasteners: Furnished as recommended by hardware manufacturers to comply with application involved (steel, wood,…), and as required to secure hardware.
4. Hand of door: The drawing shows the direction of swinging or hand of each door leaf. Furnish each item of ironmongery for proper installation and operation of the door movement as shown.
5. Product finishes: the product finish to be as indicated in schedule as selected from manufacturers wide range of finishes.

B. HINGES, BUTTS AND PIVOTS:

Provide stainless steel strap hinges or ball bearing hinges stainless steel, Butts and pivots as follows:

Number of Hinges: Unless otherwise indicated, supplier should provide number of hinges per leaf to comply with his product fire rating test / certificate. A proof of such test should be presented.
As a general recommendation, three hinges should be provided for net leaf size of 2135mm X 915mm and a fourth hinge for bigger size.

1. **Type of Hinges:**
   a. Provide strap hinges with full 5-knuckle, Two ball bearing hinges or three as shown on drawings standard weight, stainless steel in compliance with BS7352 : 1990 class 9.
   b. Provide full mortise rising hinges ,standard weight, stainless steel.

2. **Hinge size**: Unless otherwise indicated, or specified provide door hinge of 5 x 15 cm.

3. **Screws:** Furnish Philips Flat – Head machine screws for installation of units, except furnish Philips flat-head all purpose or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.

4. **Hinge pins:** Unless otherwise specified, provide hinge pins as follows:
   a. Interior doors:removable stainless steel pin
   b. Exterior doors: non-removable pin

5. **Pivots:** As recommended by manufacturer for size and weight and thickness of door, also check related drawings for further details.

C. LOCKS AND LATCHES:

1. Unless otherwise indicated or specified, provide locks and latches that comply with BS 5872: 1980.
2. Strikes: Provide manufactures standard strikes for each latch or lock bolt: with curved lip executed to protect frame, finish to match ironmongery sets.
3. Rabbeted doors: where rabetted door stiles are indicated, provide special rabetted front on lock and latch units and bolts.
4. Provide 76mm Euro profile mortise Sashlock case, 57mm backset 57mm centers, brass follower to suit 8mm spindle, with adjustable tension spring to suit heavy unsprung or sprung lever furniture meeting BS5872 and fire rated to BS476, Stainless steel finish.
5. Provide 76mm Euro profile mortise dead lock case 57mm back set, to meet BS5872 and fire rated to BS 476, stainless steel finish.
6. Provide 76mm mortise bathroom lock, 57mm backset centers with reversible latch bolt, to suit 8mm spindle with adjustable tension spring, and dead bolt follower 5mm, stainless steel.
7. Provide 76mm Euro profile mortise nightlatch lock case,57mm backset 57mm centers,brass follower to suit 8mm spindle,brass latchbolt,automatic locking action without key,when door is closed with latch bolt out,reversible latch bolt,cylinder and lever handle,to suit either hand of door.
8. Equip locks with euro profile double cylinder, 5 pins with length to match with the door thickness and the related installed accessories.
9. Equip locks with Euro-profile single cylinder,5 pins with length to match with the door thickness and the related installed accessories.
10. Equip locks with Euro-profile single cylinde plus thumbturn,5 pins with length to match with the door thickness and the related installed accessories.
11. All locks are to differ and are ensuite to grand master key, with 5 pin cylinders.
12. Provide 3 keys for each lock, finish as manufacturers standard unless otherwise indicated.
13. Provide thumbturn with indicator monitor and emergency release to comply with the provided bathroom lock, stainless steel finish.

D. FLUSH BOLTS AND DUST PROOF STRIKES:

1. **Flush Bolts:**
   a. Lever action manual flush bolt to comply with steel leaf application and fire rating. Manufacturer standard finish unless otherwise indicated.
   b. Automatic flush bolt to comply with steel leaf application and fire rating. Manufacturer standard finish unless other wise indicated.
   c. Lever action manual flush bolt to comply with wooden leaf application and fire rating. Manufacturer standard finish unless other wise indicated.
   d. Automatic flush bolt to comply with wooden leaf application and fire rating. Manufacturer standard finish unless other wise indicated.

2. **Dust proof strike:** provides dust proof strikes for foot bolts except where special threshold construction requires specific type. Finish as requested by the Engineer unless otherwise indicated.

E. EXIT DEVICES:

1. **General:** Unless otherwise indicated or specified, emergency exit devices shall comply with BS EN 1125 specification requirements for panic bolts and panic latches. And fire rated to BS 476.
   a. Cross bar exit device for single leaf with reversible panic latch and outside trim, silver finish. Location as indicated on hardware schedule.
   a. Cross bar Vertical rod panic bolt to be installed on double leaf doors with outside trim location as indicated on hardware schedule, silver finish.

PART 3 - EXECUTION

INSTALLATION

A. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way coordinate removal, storage and reinstallation or application of surface protection with finishing work specified in other sections. Do not install surface-mounted items until finishes have been completed on the substrate.

B. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

C. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

ACTIVE LEAF OF PAIRS OF DOORS

A. Active leaf of pairs of doors shall be RHRB except that where door leaves are unequal, active leaf shall be larger leaf.

HARDWARE MOUNTING HEIGHTS

A. Mount hardware units at heights generally in accordance with the following, except as otherwise required by the Engineer, or specifically indicated on drawings or required to comply with governing regulations, or avoid interferences

1. Lock Sets and Latches: 950 mm to center of lever or knob from floor.
2. Butt Hinges: 250 mm to bottom of lowest hinge from floor; 125 mm to top of upper hinge from top of door; space other hinges equally between lower and upper hinges.
3. Door Pulls: 1140 mm finish floor to center of pull; center line in 125 mm from edge of flush doors, and centered on stile of narrow stile glass doors.
4. Deadlocks: Center line of cylinder to align with center line of cylinder for lock sets, except where location conflicts with pull handle or push plate, then provide at 1520 mm from finished floor to centerline of cylinder.
5. Cross Bar Exit Devices: 910 mm for standard installations.
6. Push Rail Exit Devices: 1040 mm for standard installations.
7. Push Plate: 1220 mm finish floor to center of plate through mounted to pulls.
8. Flush Bolt Operating Mechanisms: Top bolt 1675 mm to 1830 mm above finished floor, bottom bolt 300 mm above finished floor.

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Install each ironmongery item in compliance with the manufacturers instruction and recommendations whenever cutting and fitting is required to install ironmongery onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protection. Do not install surface mounted items until finishes have been complete the substrates.

C. Set Units plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation. Separate aluminum and other corrodible metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials. Drill and countersink units which are factory prepared for anchorage fasteners, space fasteners and anchors in accordance with manufacturer’s instructions or as directed.

ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.

B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make a final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Instruct Employer's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

Hardware Schedule for Doors

Refer to drawingfor for Wooden Door Schedule, LEGEND & IRONMONGERY.

CHAPTER NINE
FINISHES

CHAPTER NINE
FINISHES

9.1 LATH AND PLASTER

PART 1 - GENERAL

SUMMARY

A. Extent of lath and plaster is indicated on Drawings and Schedules.

B. Types of work include:

1. Metal lathing.
2. Portland cement plastering.

QUALITY ASSURANCE

A. Field Construction Mock-up: Prior to installation of plaster work, fabricate mock-up panels for each type of finish and application required using materials, including lath accessories and support system (if any) indicated for final work. Build panels 1.2 m x1.2 m x full thickness in location indicated, or if not otherwise indicated, as directed by Engineer. Demonstrate the proposed range of colour, texture and workmanship to be expected in completed work. Obtain Engineer acceptance of panel's visual quality before start of work. Retain panel during construction as a standard for judging completed work.

PART 2 - PRODUCTS

LATH

A. Expanded Metal Lath: Fabricate expanded metal lath from galvanized steel sheet to produce lath complying with BS 1369 for type, configuration and other characteristics indicated below, with uncoated steel sheet painted after fabrication into lath.

1. Diamond Mesh Lath: Comply with the following requirements:

Configuration: Flat.
Weight: 1.60 kg/m2.

PLASTER ACCESSORIES FOR PORTLAND CEMENT PLASTER

A. General: Comply with material provisions of BS 1369 and BS 5262; coordinate depth of accessories with thicknesses and number of coats required.

B. Metal Corner Reinforcement: Expanded large mesh diamond mesh lath fabricated from tight coat galvanized sheet steel to comply with BS 5262, with weight 2.25 kg/m2 and formed to reinforce external corners of Portland cement plaster on exterior exposures while allowing full plaster encasement.

C. Metal Corner Beads: Small nose corner beads fabricated from tight coat galvanized sheet steel, synthetic coated fitted with PVC strip.

D. Casing Beads: Square-edged style, with expanded flanges and removable protective tape, of the following material:

1. Material: Zinc-coated steel with PVC strip.
2. Two-Piece type: Pair of casing beads with back flanges formed to provide slip joint action, adjustable for joint widths from 3 mm to 15 mm, with PVC edging.

PORTLAND CEMENT PLASTER MATERIALS

A. Base Coat Cements: Type as indicated below:

1. Portland cement, ASTM C 150, Type I or III; BS 12.

B. Finish Coat Cement: Type as indicated below:

1. Portland cement, ASTM C 150, Type I; BS 12.

C. Factory-Prepared Finish Coat: Manufacturer's standard product requiring addition of water only.

1. Product: Subject to compliance with requirements and approval of the Engineer.

D. Lime: Special hydrated lime for finishing purposes, ASTM C 206, Type S; or BS 890 Type.

E. Sand Aggregates: ASTM C 897; BS 1199.

MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Drinkable, free of substances capable of affecting plaster set or of damaging plaster, lath or accessories.

B. Bonding Agent for Portland Cement Plaster: ASTM C 932.

C. Plasticiser: Manufacturer's standard product, subject to compliance with requirements and approval of the Engineer may be used in accordance with manufacturer's recommendations and instructions.

PORTLAND CEMENT PLASTER MIXES AND COMPOSITIONS

A. General: Comply with ASTM C 926 or BS 5262 for Portland cement plaster base and finish coat mixes as applicable to plaster bases, materials and other requirements indicated.

B. Portland Cement Plaster Base Mixes and Compositions: Proportion materials for respective base coats in parts by volume for cementitious materials and in parts by volume per sum of cementitious materials for aggregates to comply with the following requirements for each method of application and plaster base indicated. Adjust mix proportions below within limits specified to attain workability.

1. Three-Coat Work over Metal Lath: Base coats as indicated below:

   Scratch Coat: 1 part Portland cement, ½ part lime, 4 parts sand.

   Brown Coat: 1 part Portland cement, ½ part lime, 4 parts sand.

2. Two-Coat Work over Concrete Unit Masonry: Base coats as indicated below.

   Base coats: 1 part Portland cement, ½ part lime, 4 parts sand.

C. At Contractor's option, provide one of the following:

1. Job-Mixed Portland Cement Plaster Finish Coats: Proportion materials for finish coats in parts by volume for cementitious materials and parts by volume per sum of cementitious materials for aggregates to comply with the following requirements:

   a. 1 part Portland cement, ¾ - 1½ parts lime, 3 parts sand.

2. Factory-Prepared Portland Cement Finish Coats: Add water only; comply with finish coat manufacturer's directions.

D. Mixing: Mechanically mix cementitious and aggregate materials for plasters to comply with applicable referenced application standard and with recommendations of plaster manufacturer.

PART 3 - EXECUTION

INSTALLATION OF LATHING AND FURRING, GENERAL

A. Portland Cement Plaster Lathing and Furring Installation Standard: Install lathing and furring materials indicated for Portland cement plaster to comply with ANSI A42.3 or BS 5262.

METAL LATHING

A. Install expanded metal lath for the following applications where plaster base coats are required. Provide appropriate type, Configuration and weight of metal lath selected from materials indicated which comply with referenced lathing installation standards.

1. At junctions and joints between differing materials and forms of construction, and at all chases and other places where making good occurs.

a. Install minimum 150 mm wide strip of lath, fixed to substrate on both edges at minimum 600 mm centres.

INSTALLATION OF PLASTERING ACCESSORIES

A. General: Comply with referenced lathing and furring installation standards for provision and location of plaster accessories of type indicated. Mitre or cope accessories at corners; install with tight joints and in alignment. Attach accessories securely to plaster bases to hold accessories in place and alignment during plastering.

B. Accessories for Portland Cement Plaster:

1. Corner Bead: Install at all external corners.
2. Casing Beads: Install at termination of plasterwork unless otherwise indicated.

PLASTER APPLICATION, GENERAL

A. Prepare monolithic surfaces for bonded base coats and use bonding compound or agent to comply with requirements of referenced plaster application standards for conditioning of monolithic surfaces.

B. Tolerances: Do not deviate more than 3 mm in 1.8 m from true plane in finished plaster surfaces, as measured by a 1.8 m straightedge placed at any location on surface.

C. Grout hollow metal frames, bases and similar work occurring in plastered areas, with base coat plaster material and prior to lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout 150 mm lengths at each anchorage.

D. Sequence plasters application with the installation and protection of other work, so that neither will be damaged by the installation of the other.

E. Apply thicknesses and number of coats of plaster as indicated; or as required by reference standards.

F. Concealed Plaster: Where plaster application will be concealed above suspended ceilings and similar locations, finish-coat may be omitted; where used as a base for adhesive application of tile and similar finishes, omit finish-coat and coordinate thickness with overall dimension as shown, and comply with tolerances specified.

PORTLAND CEMENT PLASTER APPLICATION

A. Portland Cement Plaster Application Standard: Apply Portland cement plaster materials, compositions, and mixes to comply with ASTM C 926 or BS 5262.

B. Number of Coats: Apply Portland cement plaster, of composition indicated, to comply with the following requirements:

1. Use three-coat work over metal lath.
2. Use two-coat work over the following plaster bases:

    a. Concrete unit masonry.
    b. Concrete cast-in-place or precast when surface complies with ASTM C 926 or BS 5262 for plaster bonded direct to solid base.

3. Finish Coat: Floated finish unless otherwise indicated; match Engineer sample.

C. Thickness:

1. Thickness of external plaster (render) shall be 25 mm, 3 coat application over metal lath, having smooth wood float finish.
2. Thickness of internal plaster shall be 15 mm, 2 coat application. Having smooth steel float finish.

D. Moist cure Portland cement plaster base and finish coats to comply with ASTM C 926 or BS 5262, including recommendations for time between coats and curing.

CUTTING AND PATCHING

A. Cut, patch, point-up and repair plaster as necessary to accommodate other work and to restore cracks, dents and imperfections. Repair or replace work to eliminate blisters, buckles, excessive crazing and check cracking, dry-outs, efflorescence, sweat-outs and similar defects, and where bond to the substrate has failed.

B. Sand smooth troweled finishes lightly to remove trowel marks and arises.

CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces, which are not to be plastered. Repair floors, walls and other surfaces, which have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers and equipment and clean floors of plaster debris.

B. Provide final protection and maintain conditions, in a manner acceptable to the Engineer, which ensures plasterwork being without damage or deterioration at time of Taking-Over.

9.2 CERAMIC WALL & FLOOR TILE

PART 1 - GENERAL

SUMMARY

A. Definition: Tile includes ceramic surfacing units made from clay or other ceramic materials.

B. Extent of tile works is indicated on Drawings and Schedules.

C. Types of tile work in this section include the following:

1. Non slip ceramic floor tile and base (full mass ceramic).
2. Glazed ceramic wall tile.

D. Portland cement plaster scratch coat is specified in Lath and Plaster section of the specification.

E. Sealing expansion and other joints in tile work with elastomeric joint sealers is specified in Joint Sealers section of the specification.

QUALITY ASSURANCE

A. Source of Materials: Provide materials obtained from one source acceptable to Engineer for each type and colour of tile, grout and setting materials.

B. Field-Constructed Mock-Up: Before installing tile, erect mock-ups for each form of construction and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution.

PART 2 - PRODUCTS

PRODUCTS, GENERAL

A. Standard for Ceramic Tile: comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated or BSCP 202 Tile Flooring and BS 6431 Ceramic Floor and Wall Tiles.

B. Standard for Tile Installation Materials: Comply with standard referenced with installation products and materials indicated or with BS 6431.

C. Colours, Textures and Patterns: For tile and other products requiring selection of colours, surface textures or other appearance characteristics, provide products to match characteristics indicated or, if not otherwise indicated, as selected by the Engineer from manufacturer's standard range.

1. Provide tile trim and accessories, which match colour and finish of adjoining flat tile.

TILE PRODUCTS

A. Vitrified Ceramic Floor Tile: Provide factory-mounted flat tile complying with BS 1286 type B.

1. Wear Surface: Smooth, non-slip.
2. Nominal Facial Dimension: As indicated.
3. Nominal thickness: As indicated, or 10 mm if not.
4. Face: Plain with square edges.

B. Glazed Ceramic Wall Tile: complying with BS 1281.

1. Wearing Surface: Smooth
2. Nominal Facial Dimensions: As indicated.
3. Nominal Thickness: As indicated, or 8 mm if not.
4. Face: Plain with cushion edges.

C. Base (Skirting): Cove base with square top edge; to match floor tiles; height as indicated, or 100 mm if not.

D. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:

1. Size: As indicated, coordinate with sizes and coursing of adjoining flat tile, where applicable.

2. Shapes: As follows, selected from manufacturer's standard shapes:
   a. Base: Coved with square top edge, unless otherwise indicated. Provide external and internal corner angles as required.
   b. External Corners: Rounded, unless otherwise indicated.
   c. Internal Corners: Field-butted square corners.

SETTING MATERIALS

A. Thin-set Portland Cement Mortar: Where thin-set Portland cement mortar applications are indicated, use the following unless otherwise recommended by manufacturer or required by the Engineer:

1. Latex-portland cement mortar.
2. Epoxy mortar.
3. Organic adhesive.

MISCELLANEOUS MATERIALS

A. Tile Cleaner: Product specifically acceptable to tile manufacturer and grout manufacturer for application indicated.

MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content; type of mixing equipment, selection of mixer speeds, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

EXAMINATION

A. Examine substrates and areas where tile will be installed, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, and free from oil or waxy films and curing compounds.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

FLOOR INSTALLATION METHODS

A. Ceramic Floor Tile and Base: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types.

1. Portland Cement Mortar: ANSI A108.1

    a. Bond Coat: Portland cement paste on plastic bed; or thin-set portland cement on cured bed, ANSI A108.5, at Contractor's option.
    b. Concrete Subfloors, Interior: TCA F112.
    c. Grout: Latex-portland cement.

2. Organic Adhesive: ANSI A108.4

    a. Concrete Subfloors, Interior: TCA F116 .
    b. Grout: Latex-portland cement.

WALL TILE INSTALLATION METHODS

A. Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:

1. Organic Adhesive: ANSI A108.4.

    a. Solid Backing, Interior: TCA W223.
    b. Grout: Latex-portland cement, with waterproofer.

CLEANING AND PROTECTION

A. Cleaning: Upon completion of placement of grouting, clean all ceramic tile surfaces so they are free from foreign matter.

1. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

B. Finish Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded or otherwise defective tile work.

C. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

1. Prohibit foot and wheel traffic from using tiled floor for at least 7 days after grouting is completed.

2. Before final inspection, remove protective coverings and rinse neutral cleaning from tile surface.

ADJUST AND CLEAN

A. Immediately after application, remove surplus adhesive.

B. When materials have sufficiently seated, clean resilient base and adjoining surfaces in accord with manufacturer's recommendations.

C. Leave smooth and clean.

9.8 PAINTING

PART 1- GENERAL

SUMMARY

A. Extent of painting work is indicated and Drawings, schedules and herein, and includes surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Engineer will select from standard manufacturer's colors or finishes available.

1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.

1. Prefinished items not to be painted include all factory-finished components such as:

a. Prefinished metal fabrications.
b. Acoustic ceilings.
c. Joinery and architectural woodwork.
d. Elevator equipment.
e. Finished mechanical and electrical equipment.
f. Light fixtures.
g. Switchgear.
h. Distribution cabinets.

2. Finished metal surfaces not to be painted include:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.

3. Operating parts not to be painted include moving parts of operating equipment such as the following:

    a. Valve and damper operators.
    b. Linkages.
    c. Sensing devices.
    d. Motor and fan shafts.

4. Labels: Do not paint over regulation or code-required labels or equipment name, identification, performance rating, or nomenclature plates.

DEFINITIONS

A. "Paint" includes coating systems materials; primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

PART 2 - PRODUCTS

MATERIALS, GENERAL

A. Material Quality: Provide only best quality grades for the various types of coatings and paint systems required, as regularly manufactured and recommended by acceptable paint manufacturers. Paint material containers not displaying manufacturer's names and product identification will not be acceptable.

1. Proprietary names used to designate colours or materials are not intended to imply that products of named manufacturers are required or to exclude equivalent products of other manufacturers.

B. Colour Pigments: Pure, non-fading, applicable types to suit substrates and services indicated.

1. Lead contents in pigment, if any, is limited to contain not more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint be weight.

FIELD QUALITY CONTROL

A. The Engineer reserves the right to request the following test procedure at any time and as often as the Engineer deems necessary during the period when paint is being applied:

1. The Contractor shall engage the services of an independent testing laboratory approved by the Engineer to sample the paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. The testing laboratory will perform appropriate tests for all or any of the following characteristics as required by the Engineer:

a. Quantitative materials analysis.
b. Abrasion resistance.
c. Apparent reflectivity.
d. Flexibility.
e. Wash ability.
f. Absorption.
g. Accelerated weathering.
h. Dry opacity.
i. Accelerated yellowness.
j. Recoating.
k. Skinning.
l. Color retention.
m. Alkali and mildew resistance.

3. If test results show material being used does not comply with specified requirements, the Contractor may be directed to stop painting, remove noncomplying paint from the site and repaint surfaces coated with rejected paint, and remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are noncompatible.

PART 3 - EXECUTION

EXAMINATION

A. Examine substrates, areas, and conditions under which painting will be performed for compliance with paint application requirements. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean/prepare surfaces according to manufacturer's written instructions for each particular substrate condition to be painted.

D. Materials Preparation: Mix/prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Surface treatments and paint finishes are indicated in the schedules.
   2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   3. Provide finish coats that are compatible with primers used.
   4. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   5. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
   6. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

   1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions sand between applications.
   2. Omit primer on metal surfaces that have been shop primed and touchup painted.
   3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
   4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, or other applicators according to manufacturer's written instructions.

   1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.

   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

G. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

PROTECTION

A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Engineer.

B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

PART 4 - PAINT SCHEDULES

EXTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates indicated.

B. Ferrous Metal: Primer is not required on shop-primed items.

1. Full-Gloss Alkyd Enamel: 2 finish coats over primer.

   a. Primer: Synthetic Rust-Inhibiting Primer.
   b. First and Second Coats: Alkyd Gloss Enamel.

2. Lusterless Alkyd Enamel: 2 finish coats over primer.

   a. Primer: Synthetic Rust-Inhibiting Primer.
   b. First and Second Coats: Lusterless Alkyd Enamel.

C. Zinc-Coated Metal:

1. Full-Gloss Alkyd Enamel: 2 finish coats over primer.

   a. Primer: Galvanized Metal Primer.
   b. First and Second Coats: Alkyd Gloss Enamel.

INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates, as indicated.

B. Concrete and Plasters.

1. Lusterless (Flat) Emulsion Finish: 3 coats.

   a. Primer: Latex-Based Interior Flat Paint.
   b. Under Coat: Latex-Based Interior Flat Paint.
   c. Finish Coat: Latex-Based Interior Flat Paint.

2. Odorless Lusterless (Flat) Latex Finish: 3 coats.

   a. Primer: Latex-Based Interior Flat Paint.
   b. First Coat: Latex-Based Interior Flat Paint.
   c. Second Coat: Interior Flat Odorless Alkyd Paint.

3. Semigloss Enamel Finish: 3 coats with total dry film thickness not less than: 0.09 mm, on concrete, 0.06mm on plaster.

    a. Primer: Latex-Based Interior Flat Paint.
    b. Undercoat: Interior Enamel Undercoat.
    c. Finish Coat: Interior Semigloss Odorless Alkyd Enamel.

4. Plastic Coating Finish: Multiple coating system including preparation sealer, primer and undercoats; applied in strict accordance with manufacturer recommendations and instructions for substrate and purpose of use.

    a. Purpose : Provision of a heavy duty washable, monolithic and anti-bacterial surface finish to cement plastered walls and ceilings in hospital rooms and areas requiring a high degree of cleanliness and hygiene.
    b. Available Products: subject to compliance with requirements, products which may be incorporated, in the work include, but are not limited to:

C. Concrete Masonry Units:

1. Lusterless (Flat) Emulsion Finish: 2 finish coats over filled surface.
    a. Latex Block Filler.
    b. First and Second Coats: Latex-Based Interior Flat Paint.

2. Semigloss Alkyd Enamel Finish: 2 coats over filled surface with total dry film thickness not less than 0.09 mm, excluding filler coat.

    a. Latex Block Filler.
    b. Undercoat: Interior Enamel Undercoat.

    c. Finish Coat: Interior Semigloss Odorless Alkyd Enamel.

D. Painted Wood and Hardboard:

1. Semigloss Enamel Finish: 3 coats.

    a. Undercoat: Interior Enamel Undercoat .
    b. First and Second Coats: Interior Semigloss Odorless Alkyd Enamel .

2. Full-Gloss Enamel Finish: 3 coats.

    a. Undercoat: Interior Enamel Undercoat .
    b. First and Second Coats: Alkyd Gloss Enamel.

E. Ferrous Metal:

1. Lusterless (Flat) Finish: 3 finish coats over primer with total dry film thickness not less than 0.06 mm.
   a. Primer: Synthetic Rust-Inhibiting Primer.
   b. First and Second Coats: Latex-Based Interior Flat Paint.

2. Semigloss Enamel Finish: 2 coats over primer with total dry film thickness not less than 0.06 mm.

   a. Primer: Synthetic Rust-Inhibiting Primer.
   b. Undercoat: Interior Enamel Undercoat.
   c. Finish Coat: Interior Semigloss Odorless Alkyd Enamel.

F. Zinc-Coated Metal:

1. Lusterless (Flat) Finish: 2 finish coats over primer with total dry film thickness not less than 0.06 mm.

   a. Primer: Galvanized Metal Primer.
   b. First and Second Coats: Latex-Based Interior Flat Paint.

2. Semigloss Finish: 2 coats over primer, with total dry film thickness not less than 0.06 mm.

   a. Primer: Galvanized Metal Primer.
   b. Undercoat: Interior Enamel Undercoat.
   c. Finish Coat: Interior Semigloss Odorless Alkyd Enamel.

3. Full-Gloss Enamel Finish: 2 Coats over primer with total dry film thickness not less than 0.06mm.

   a. Primer: Galvanized Metal Primer.
   b. Undercoat: Interior Enamel Undercoat.
   c. Finish Coat: Alkyd Gloss Enamel.

CHAPTER TEN
SPECIALTIES

CHAPTER TEN
SPECIALTIES

10.1 Toilet Accessories

PART 1 - GENERAL

DESCRIPTION OF WORK

A. Furnish and install the following toilet accessory items as indicated on Drawings and/or required by Engineer:
   1. Toilet roll lockers.
   2. Soap holders and soap box.
   3. Paper holder.
   4. Mirror units.

   All as indicated in details on drawings.

PART 2 - PRODUCT

As stated on drawings.

PART 3 - EXECUTION

INSTALLATION

A. Install toilet accessory and mirror units in accordance with manufacturer's instructions, using purpose concealed fasteners appropriate to substrate and recommended by manufacturer of unit. Install units plumb, level and square, firmly anchored in locations and at heights indicated.
   1. Mirrors: Provide plywood backing panels, filters and other ancillaries as indicated and required.

ADJUSTING AND CLEANING

A. Adjust toilet accessories for proper operation and verify that mechanisms functions smoothly. Replace damaged or defective items.

B. Clean and polish all exposed surface not more than 4 days prior to date scheduled for inspections intended to establish date for substantial completion, in strict accordance with manufacturer's recommendations after removing temporary labels and protective coatings.

CHAPTER THREE
CONCRETE WORKS

CHAPTER THREE
CONCRETE WORKS

3.1 CAST IN PLACE CONCRETE

PART 1 - GENERAL

SUMMARY

A. Extent of cast in place concrete work is shown on Drawings.

PROJECT CONDITIONS

A. Protect adjacent finish materials against spatter during concrete placement.

B. Protection of fresh concrete against hot weather: Cover completed fresh concrete with temporary cover as required to protect newly cast elements from direct sun light in hot weather - above 35 deg. C; maintain cover for time period until curing starts.

C. Protect surfaces from rain, wind and sun, detention and physical damage.

D. Protect immature concrete from physical shock, movement, thermal shock and cold water.

PART 2 - PRODUCTS

REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615; BS 4449, 4461

B. Steel Wire: ASTM A 82, plain, cold-drawn steel.

C. Welded Wire Fabric: ASTM A 185; BS 4483

D. Supports for Reinforcement; Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place.

1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected or stainless steel protected.

CONCRETE MATERIALS

A. Ordinary Portland cement: ASTM C 150 Type I; BS12.

B. Sulphate-Resisting Portland cement: ASTM C 150 Type V; BS 4027

C. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.

D. Normal Weight Aggregates: ASTM C 33; BS 882 and as herein specified. Provide aggregates from a single source for exposed concrete.

1. Do not use fine or coarse aggregates containing spalling-causing deleterious substances and this should have a sand equivalent more than 70.

2. Local aggregates not complying with the standards stated but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Engineer.

E. Water: Potable, free from foreign material in amounts harmful to concrete or embedded steel.

RELATED MATERIALS

A. Epoxy Adhesive: ASTM C 8891, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements.

PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. For information, submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until the acceptability of each mix has been adequately substantiated by the Contractor according to ACI 301, as judged by the Engineer.

C. Design mixes in accordance with the following table. Ensure quantity of water used does not exceed that required to produce a concrete with sufficient workability to be placed and compacted where required.

DESIGNED MIXES

Class of Concrete	AA	A	B	C
Minimum cement quantity per m3 of concrete (kg)	450	400	350	250
Water cement ratio	0.48	0.48	0.49	0.58
Preliminary Test Cylinders: Minimum Compressive Strength at 28 Days (kg/cm2)	400	350	280	180
Works Test Cylinders Minimum: Compressive Strength at 28 Days (kg/cm2)	350	300	250	175
Method of compacting of concrete when placed	Vibrated	Vibrated	Vibrated	Rodded, or Tamped

Keep slump to the minimum compatible with approved placing requirements.

CONCRETE MIXING

A. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

C. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required and shall be subject to the Engineer's approval.

PART 3 - EXECUTION

GENERAL

A. Coordinate the installation of joint materials and water proofing membranes with placement of forms and reinforcing steel

FORMS

A. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size shape, alignment, elevation, and position. Maintain formwork construction tolerances complying with ACI 347.

B. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

    1. Avoid cutting or puncturing water proofing membranes during reinforcement placement and concreting operations.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials, which reduce or destroy bond with concrete

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.

D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surface.

E. Install welded wire fabric in as long lengths as practicable. lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuos laps in either direction.

JOINTS

A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.

B. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

C. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instruction.

D. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

    1. Joint filler and sealant materials are specified in elsewhere in the specifications.

CONCRETE PLACEMENT

A. Replacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

   1. Apply temporary protective covering to lower 600 mm of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

B. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.

C. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

D. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

E. Maintain reinforcing in proper position during concrete placement operations.

F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

G. When air temperature has fallen to or is expected to fall below 36 deg F (2 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F(27 deg C) at point of placement.

H. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from direct exposure to wind, from premature drying and from excessive cold or hot temperatures.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist and covered for not less than 7 days.

C. Begin final curing procedures immediately following initial curing and before concrete have dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

D. Curing methods: Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

E. Provide moisture curing by following methods.

1. Keep concrete surface continuously wet by covering with water.

F. Cover concrete surfaces with moisture retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 74 mm and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

SHORES AND SUPPORTS

A. Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.

B. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stree or deflection.

C. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at no less than 50 deg F (10 deg C) for 36 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and not until concrete has attained 28 day design strength unless authorized by Engineer. Determine potential compressive strength of inplace concrete by testing field-cured specimens representative of concrete location or members.

C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Contractor will employ a testing laboratory approved by the Engineer to perform tests and to submit test reports.

B. Sampling and testing for quality control during placement of concrete may include all types of testing as directed by the Engineer.

C. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

D. Test results will be reported in writing to. Engineer within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

3.2 CONCRETE TOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Decorative stamped concrete floor topping.

1.2 ACTION SUBMITTALS

A. Product Data: product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR TOPPINGS

A. Stamped-Aggregate Concrete Floor Topping: Factory-prepared and dry-packaged mixture of containing mineral oxide; portland cement; plasticizers; and other admixtures to which only water needs to be added at Project site.

1. Products: Subject to compliance with requirements, provide available products that may be incorporated into the Works and which are deemed in the market.
   a. Compressive Strength (28 Days): 4000 psi; ASTM C 109/C 109M
   b. Slump in concrete shall not exceed 10 cm

2.2 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 25 percent solids content, minimum.

F. Apply a color hardener at the minimum 30 kg / 10 sq.m

2.3 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, [**epoxy resin with a Type A Shore durometer hardness of 80**] per ASTM D 2240.

B. Joint-Filler Strips: [**ASTM D 1751, asphalt-saturated cellulosic fiber**].

C. Portland Cement: ASTM C 150, Type I or II.

D. Sand: ASTM C 404, fine aggregate passing No. 16 (1.18-mm) sieve.

E. Water: Potable.

F. Acrylic-Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

G. Epoxy Adhesive: ASTM C 881/C 881M, Type V, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

2.4 MIXING

A. Bonding Slurry: Mix portland cement with water to a thick paint consistency.

B. Bonding Slurry: Mix 1 part portland cement and [**1-1/2**] parts sand with water [**and an acrylic-bonding agent according to manufacturer's written instructions**] to a thick paint consistency.

C. Floor Topping: Mix concrete floor topping materials and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of (6 mm).

1. Prepare and clean existing base slabs according to concrete floor topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.

2. Saw cut contraction and construction joints in existing concrete to a depth of (35-50 mm) and fill with semirigid joint filler.

3. To both sides of joint edges and at perimeter of existing base slab [**mechanically remove a (100-mm-) wide and (0- to 25-mm-) deep, tapered wedge of concrete and retexture surface**].

B. Install joint-filler strips where topping abuts vertical surfaces.

3.2 FLOOR TOPPING APPLICATION

A. Start floor topping application in presence of manufacturer's technical representative.

B. Monolithic Floor Topping: After textured-float finish is applied to fresh concrete of base slabs specified in Division 03 Section "Cast-in-Place Concrete," place concrete floor topping while concrete is still plastic.

C. Deferred Floor Topping: Within 72 hours of placing base slabs, mix and scrub bonding slurry into dampened concrete to a thickness of (1.6 to 3 mm), without puddling. Place floor topping while slurry is still tacky.

D. Existing Concrete: Apply epoxy-bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of (1.6 to 3 mm), without puddling. Place floor topping while adhesive is still tacky.

E. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.

1. Screed surface with a straightedge and strike off to correct elevations.
2. Slope surfaces uniformly where indicated.
3. Begin initial floating using bull floats to form a uniform and open-textured surface plane free of humps or hollows.

F. Finishing: Consolidate surface with power-driven floats as soon as concrete floor topping can support equipment and operator. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until concrete floor topping surface has a uniform, smooth, granular texture.

1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate concrete floor topping by power-driven trowel without allowing blisters to develop. Continue troweling passes and restraighten until surface is smooth and uniform in texture.

G. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of concrete floor topping, at locations indicated or as approved by Architect.

1. Coat face of construction joint with epoxy adhesive at locations where concrete floor topping is placed against hardened or partially hardened concrete floor topping.

H. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut (5-mm-) wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.
1. Form joints in concrete floor topping over contraction joints in base slabs, unless otherwise indicated.
2. Construct contraction joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.
3. Construct contraction joints for a depth equal to one-half of concrete floor topping thickness, but not less than (13 mm) deep.

3.3 PROTECTING AND CURING

A. General: Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to concrete floor topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying floor topping, but before float finishing.

C. Begin curing immediately after finishing concrete floor topping. Cure by one or a combination of the following methods, according to concrete floor topping manufacturer's written instructions:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete for not less than seven days.
3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions.

3.4 JOINT FILLING

A. Prepare and clean contraction joints and install semirigid joint filler, according to manufacturer's written instructions, once topping has fully cured.

B. Install semirigid joint filler full depth of contraction joints. Overfill joint and trim semirigid joint filler flush with top of joint after hardening.

3.5 REPAIRS

A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

UNITED NATIONS

DEVELOPMENT PROGRAMME
LEBANON

PROFESSIONAL SERVICES FOR THE DESIGN AND SUPERVISIONS OF REHABILITATION AND CONSTRUCTION PROJECTS ON LONG TERM AGREEMENT (LTA) basis

Ref.: LEB/CO RFP/11/17

Construction of a Homemade Food Market in Anjar

VOLUME 2
SPECIFICATIONS

PART 3
ELECTRICAL ENGINEERING SERVICES

Ref: L-2017-03-C
SEPTEMBER 2017

CONSTRUCTION OF A HOMEMADE FOOD MARKET ANJAR – LEBANON

VOLUME 2
SPECIFICATIONS

PART 3
ELECTRICAL ENGINEERING SERVICES

TABLE OF CONTENTS

CHAPTER 1
BASIC ELECTRICAL REQUIREMENTS

CHAPTER 1
BASIC ELECTRICAL REQUIREMENTS

1 - GENERAL

1.1. RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other chapters of part 3.

1.2. SCOPE OF WORK

1.2.1 The scope of electrical work for the Project will include but is not necessarily limited to:

A. Power Supply and Distribution consisting of:
- Sub-distribution and final branch circuit panelboards,
- Cables, wires and related accessories,
- Conduits, wireways, supporting systems and related accessories,
- Earthing system.

B. Lighting and Power Installations including:
- Functional indoor and outdoor lighting installations,
- Wiring devices including all lighting switches, isolating switches, socket - outlets, plates,

1.2.2. Unless otherwise specified, includes the supply, installation, testing and commissioning of the complete electrical systems, equipment and materials shown on the Drawings and/or described in the Specification together with all associated ancillary work, support work and builder's work in connection.

1.2.3. Incoming power supply and connection will be provided by the Local Power Authority at 220/380 V to the location shown on the Drawings.

1.3. GENERAL REQUIREMENTS

1.3.1. INSTALLATIONS GENERALLY:

A. Carry out electrical work in accordance with the Drawings, Specification and Regulations, ensuring compliance with design and performance requirements, to provide safe and protected systems with equipment readily accessible for operation, maintenance and repair

B. Installations are to be complete, ready for operation and fully integrated and coordinated with all other work

C. Installations are to be carried out by qualified personnel

D. Provide accessories necessary to complete the installations, of the types specified or recommended for the purpose by the manufacturer of the equipment or accessories.

1.4. DESIGN CONDITIONS

1.4.1. Nominal characteristics of power supply and distribution are as follows:

A. low voltage : 380 V, 3 phase, 4 wire, solidly earthed neutral

B. frequency : 50 Hz.

1.4.2. DISTRIBUTION SYSTEMS are to be supplied or derived from the voltage system previously described, as shown on the Drawings, or as otherwise specified.

1.4.3. EQUIPMENT is to be designed for the system voltage and frequency previously described, unless otherwise specified. Special provisions are to be made for equipment sensitive to power supply frequency and voltage variations and for equipment operated at other voltages/frequencies or by direct current sources.

1.4.4. CLIMATIC CONDITIONS: equipment, including transformers, switchgear, cables, relays, lighting fixtures, motors etc., is to be designed and derated for continuous and trouble free service under the following climatic conditions:

A. altitude : at sea level

B. maximum ambient temperature: 40 deg. C (in the shade)

C. minimum ambient temperature: 4 deg. C

D. maximum relative humidity: 90 %

E. atmospheric conditions: 1 bar

Where design and operating conditions, different from the above are required for particular equipment, they are described in the specification of the equipment concerned.

1.4.5. REGULATIONS: carry out electrical work in accordance with the current issue of the local codes of practice, local power authority regulations and IEC Regulations for Electrical Installations, where not in contradiction with the local codes of practice and regulations, herein referred to collectively as 'the Regulations'.

1.4.6. STANDARDS: unless otherwise specified, equipment and materials are to be manufactured and installed in compliance with the relevant recommendations of the following:

IEC	:	The International Electro-technical Commission
ISO	:	The International Standardization Organization
EN	:	European Norm
NF-USE	:	The French Regulation
BS	:	British Standards

or other equal and approved standards, herein referred to as 'the Standards'. Local standards, where enforced and relevant, are to have precedence over the Standards.

1.5. EQUIPMENT AND MATERIALS

1.5.1. AVAILABILITY: confirm availability of equipment and materials proposed for use in the work prior to submission for approval. If, after approval, equipment or materials cease to be available, submit alternative items of equal quality and type for approval.

1.5.2. ACCEPTANCE BY AUTHORITY: confirm that proposed equipment and material characteristics where required are compatible with the requirements of the Local Power Authority or other authorities having jurisdiction and are acceptable to them. Inform the Engineer of any modifications necessary to comply with the Local Power Authority's requirements.

1.5.3. MANUFACTURERS' STANDARDS: equipment is to be the latest standard product of the manufacturer. Component parts are to be the product of a single manufacturer, unless otherwise approved and provided that components made by other manufacturers are of a standard design and are interchangeable.

1.5.4. APPROVED MANUFACTURERS: listing of approved manufacturers in the Specification does not necessarily constitute approval of their standard products as equal to those specified. As certain that listed manufacturers are able to supply equipment and material in conformity with the Specification.

1.5.5. LABEL AND IDENTIFY all equipment, instruments, control and electrical devices etc. to indicate duty, service or function, to the satisfaction of the Engineer. Labels are to be laminated plastic or anodized aluminum discs with black surface and white core with incised lettering in English or Arabic to the satisfaction of the Engineer. Alternative methods of labelling may be submitted for approval. Fix labels with non-corrodible screws to equipment, or to adjacent permanent surfaces or as approved by the Engineer.

1.5.6. EQUIPMENT NAMEPLATES are to be non-corroding, robust metal, inscribed in English, and firmly fixed to equipment at factory. Nameplates are to indicate name and address of manufacturer, model, serial number, basic characteristics and ratings of equipment and are to include elementary diagrams etc., all in accordance with the Standards.

1.6. SUBMISSIONS

1.6.1. GENERALLY: submit for approval, manufacturers' technical literature, shop and construction drawings and other information required by the Specification, before ordering equipment or materials and before executing any related work on site.

1.6.2. TECHNICAL LITERATURE is to include detailed manufacturers' specifications and original catalogues or catalogue cuts, characteristics, model number, application and operating criteria of all equipment and materials, together with other information necessary to satisfy the Engineer that proposed equipment and systems are suitable and adequate.

1.6.3. SHOP AND CONSTRUCTION DRAWINGS are to demonstrate to the Engineer that the design requirements are understood by indicating all equipment and material proposed to be supplied and installed and by detailing fabrication and installation methods proposed to be used. Shop and construction drawings are to clearly state the name and location of the work, the names of the Engineer and Contractor, submission date, cross-references to the Drawings and Specification and the specific reference number, location, service and function of each item.

1.6.4. LIST OF PROPOSED MANUFACTURERS of all equipment and materials, including all items for which choice of manufacturer is at the discretion of the Contractor, is to be submitted for approval.

1.6.5. TEST CERTIFICATES AND REPORTS: where required by the Specification, submit manufacturer's type and routine test certificates and reports for equipment and devices. Complete test results are to be submitted in clearly identified and organized booklets, indicating item of equipment, make, model, type, date of tests, type of tests, descriptions and procedures.

1.6.6. LABORATORY TESTS: if manufacturer's test certificates are considered unsatisfactory, then independent laboratory tests are to be carried out on equipment in accordance with the Specification and the Standards, as required by the Engineer.

1.6.7. SPARE PARTS SCHEDULES: submit with the Tender itemised schedules of spare parts to be provided, as required by the Specification, and state against each item the manufacturer's unit price including packaging and delivery to site.

1.6.8. TOOLS AND INSTRUMENTS SCHEDULES: submit with the Tender itemized schedules of tools and instruments to be provided, as required by the Specification, and state against each item the manufacturer's unit price including packaging and delivery to site.

1.6.9. LABELLING SCHEDULE: submit for approval, prior to installation, a schedule of all equipment and devices to be labeled and the suggested details, lettering, position and fixing methods of each label indicating its application.

1.6.10 SAMPLES: submit samples of all equipment and materials for approval. Major items of equipment for which samples cannot be submitted are to be demonstrated in existing installations or by manufacturer's information, test certificates and reports.

2 - TESTS ON SITE, RECORDS, TRAINING AND MAINTENANCE

2.1. TESTS ON SITE

2.1.1. GENERALLY: carry out inspection and acceptance tests on site on each complete system, before final placement into service, in accordance with the Regulations and Standards, as described in the Specification and required by the Engineer.

2.2. RECORDS

2.2.1. GENERALLY: not later than the date of substantial completion, provide the Engineer with four copies of all approved as-installed drawings, test records, manufacturers' guarantees and warranties, operating and maintenance manuals and other records required by the Specification.

2.2.2. OPERATING AND MAINTENANCE MANUALS are to contain the following:

A. Technical description of each system and item of equipment installed, written to ensure that the Employer's staff fully understand the scope and facilities provided.

B. Schedules (system by system) of equipment installed giving manufacturer, catalogue list numbers, model, rating, capacity and operating characteristics; each item is to have a unique code and number, cross- referenced to the diagrammatic drawings and layout drawings.

C. Manufacturers' lists of recommended spare parts for items subject to wear and deterioration, giving expected running period and indicating specifically those items which may involve extended deliveries.

2.3. MAINTENANCE

2.3.1. MAINTENANCE CONTRACTS: where required by the Specification, submit supplementary proposals for annual maintenance contracts. The proposals are to:

A. include for maintaining the installations in efficient working order including routine and emergency service checks, adjustments, lubrication and the supply and replacement of damaged parts etc.

B. set out the terms of the offer, the work to be carried out, the guarantees of performance and the price of the work or part thereof for the first twelve months after substantial completion.

The proposals will not be considered as part of the Tender.

CHAPTER 2
DISTRIBUTION, SUBDISTRIBUTION AND FINAL BRANCH CIRCUIT PANELBOARDS

CHAPTER 2
DISTRIBUTION, SUBDISTRIBUTION AND FINAL BRANCH CIRCUIT PANELBOARDS

1. GENERAL

A. ELECTRICAL WORK GENERALLY is to be in accordance with the requirements of the chapter1 of the Specification.

B. DESCRIPTION OF WORK: panelboards for distribution and subdistribution of electric power and for protection of circuits, including fixing and supporting materials and materials for termination of feeders, sub-circuits and branch circuits.

C. STANDARDS: panelboards generally are to comply with the requirements of IEC EN 60439-1, Factory-Built Assemblies of Low Voltage Switchgear and Control Gear. Exceptionally, they may not be factory-built nor type tested.

D. DESIGNATIONS: panelboards are designated on the Drawings and in the Schedules as follow:

1. Final branch circuit panelboards, power panelboards and subdistribution panelboards respectively, for secondary lighting and power distribution with either miniature circuit breaker (MCB) or moulded case circuit breaker (MCCB) protection on subfeeder or branch circuits, as shown on the Drawings.

E. EQUIPMENT DATA: submit data for approval including, but not limited to, the following:

1. Manufacturers' catalogues indicating specific equipment selected.

2. Types of panelboards and circuit breaker characteristics including duties and ratings compensation at and above 40 deg. C ambient conditions and corresponding temperatures within the enclosures.

3. Dimensions of panels and specific contents of each panelboard.

4. Integrated equipment tabulations for coordinated short- circuit series combinations of circuit breakers (cascading and discrimination).

F. TESTS AND CERTIFICATES: submit complete certified manufacturer's type test and routine test records in accordance with the Standards.

G. APPROVED MANUFACTURERS: obtain panelboards from one of the following:

1.	Merlin Gerin, Telemecanique (Schneider)	(France)
2.	Klockner Moeller	(Germany)
3.	ABB	(Germany)
4.	Siemens – ITE	(Germany)
5.	Legrand	(France)

2. PRODUCTS AND SYSTEMS

2.1 DISTRIBUTION, SUBDISTRIBUTION PANELBOARDS

2.1.1. GENERAL REQUIREMENTS

A. RATED INSULATION VOLTAGE is to be in accordance with the respective Standards.

B. PANELBOARDS are to be totally enclosed, dead front type, protection code IP 42 for indoor installations and IP 55 for outdoor installations, in accordance with IEC 529, and are to be factory designed and assembled.

C. EARTHING BAR is to be provided in every panelboard.

D. PROTECTION is to be fully rated throughout the systems.

E. CIRCUIT BREAKERS are to be non-fused type.

2.1.2. PANELBOARD ENCLOSURES

A. TYPE: general purpose type, suitable for relevant ambient conditions, flush or surface mounted as shown on the Drawings, comprising box, trim, or trim and door to approved manufacturer's standards and sizes.

2.1.3 BUSBARS

A. TYPE: one piece, 98% pure electrolytic copper, based on maximum total temperature rise of 20 deg. C over an ambient of 40 deg. C at full continuous rating. Bolted contact surfaces are to have maximum current density not exceeding requirements of the approved standards. Aluminum is not to be used for busbars or panelboard parts.

B. DESIGN: busbars are to be shrouded/insulated and rigidly designed so that branch circuit devices can be removed without disturbing adjacent units or changed without additional machining, drilling or tapping. Busbars are to be full size without reduction. Busbar System and blank plates are to allow installation of future circuit devices, where indicated on the Drawings.

C. NEUTRAL BAR is to be solid and fully insulated from cabinet or box. One solder-less box type set-screw connector is to be provided for neutral wire of each branch circuit and one bolted clamp-type connector or anti-turn lug with set-screw for main incoming neutral wire. Neutral is to be fully sized and rated as for phase busbars.

D. EARTHING BAR is to be copper, brazed to panelboard cabinet, with bolted pressure connector for main conductor and one set-screw-type tunnel terminal for each outgoing conductor, to provide secure and reliable contact with all metal parts and enclosure.

2.1.4 MOULDED CASE CIRCUIT BREAKERS (MCCBs)

A. TYPE: tested to approved standards, totally enclosed, moulded case, constructed from high quality, high temperature resistant, tropicalized, moulded insulating materials, for normal operation at maximum temperature within enclosures at point of application, and provided with front operated single toggle type handle mechanism for manual operation of main contacts in addition to automatic operation under overcurrent and short circuits conditions. Multi-pole breakers are to have common integral trip bar for simultaneous operation of all poles. Ampere rating is to be clearly visible. All terminals are to be box lug or clamp type with set screws, suitable for copper or aluminum.

B. MCCBs FOR SDB: To comply with IEC947-2 test sequences I, II, III, utilization category A, and are to have rated service short circuit breaking capacities to meet the electrical requirements at the panelboard location.

C. FRAME SIZE is defined as maximum continuous current rating of circuit breaker which corresponds with its maximum trip range and which is to be related to minimum acceptable short-circuit interrupting ratings, based on fully rated interrupting duties: normal duty (N), high break (H), or current limiting (L), as specified.

D. RESIDUAL CURRENT OPERATED EARTH LEAKAGE TRIP DEVICES (RCDs) are provided as add-on or built-in earth leakage accessories, where required and as shown on the Drawings. Protection against earth fault current, in addition to overcurrent and short-circuit protection, is to be in accordance with the Regulations. Trip current sensitivity on breakers for branch circuits is to be 30 mA, and for main breakers ratings are to be as shown on the Drawings. Circuit breakers are to include current transformer with tripping coil assembly, test button and trip free mechanism to ensure circuit breaker cannot be held closed against earth faults.

2.1.5 MINIATURE CIRCUIT BREAKERS (MCBs)

A. TYPE: thermal magnetic non-adjustable type, tested in accordance with IEC 947.2 & IEC 898. Breaker type and short circuit interrupting ratings are mentioned on design drawings.

B. MINIMUM SHORT-CIRCUIT BREAKING CAPACITIES are to be as shown on drawings. Contractor to check and confirm those levels (according to final equipment location: Transformers, MDBs, Panel Boards,….)

C. CONSTRUCTION: MCBs are to be tropicalized for operation at ambient temperatures up to 70 deg. C within panelboard enclosure and humidity up to 95%, and are to be constructed from high quality, high temperature, moulded insulating materials. Guaranteed duties and characteristics are to be submitted for temperatures above 40 deg. C. MCBs and combinational devices are to be modular, of unified profile and mounted to a standard DIN rail.

D. OPERATION: under overload conditions, thermal tripping is to provide close protection of insulated conductors. Under short-circuit conditions, magnetic trip is to operate at 5-10 times normal rated current (curve C characteristic). Magnetic operation is to be in the current limiting region and opening time is not to exceed 5 milli-seconds.

E. RATINGS: preferred rated currents are to be 6, 10, 16, 20, 25, 30, 40, 50, 60, 80 and 100 A, calibrated at 40 deg.C, available as 1+N, 2, 3 and 4-pole circuit breakers. Derating above 40 deg. C is not to exceed 1% per deg.C, and loading is not to exceed 70% of circuit breaker rating.

F. RESIDUAL CURRENT DEVICES for earth leakage protective circuit breakers are to be add-on devices, or built-in and integral with the standard circuit breaker. Non-adjustable sensitivities of 30 mA, 100 mA and 300 mA are to be available for all ratings of 1+N, 2-pole and 4-pole circuit breakers.

2.2 PANELBOARDS

A. ARRANGEMENT: to comprise set of homogeneous branch circuit breakers with unified profile and base, and one main circuit breaker or switch (as shown on drawings). Circuit breakers or other devices are to occupy modular spaces. Accommodation of contactors and split-bus arrangement or other devices is not to change regularity of standard box width.

2.2.1. FINAL BRANCH CIRCUIT PANELBOARDS SDB- TYPE MCB

A. INTERNAL ASSEMBLY: to comprise removable back plate or back pan of rigid construction, attached to enclosure by four captive screws through keyhole fixings, and provided with DIN rails in horizontal arrangement for single and three phase panels. Assembly is to be complete with earthing bar and one piece insulated bolt-on/comb-type phase busbar. Busbars are to be single-phase and neutral or 3-phase and neutral with spade connectors for fixing by tightening a single screw on circuit breaker. Insulation is to be high thermal rating, capable of carrying maximum short-circuit current for one second without overheating beyond acceptable limits required by the Standards. Panelboards are to comply with NFC and IEC standards. If the busbars rating exceeds 100 Amp (where the frame size of the main breaker is larger than 100 Amps), comb busbars shall not be used but still clause 2.1.3. of this specification shall apply.

B. SINGLE PHASE TYPE PANELBOARDS are to be suitable for 240 V maximum service voltage, single-phase and neutral, with MCBs on branch circuits and main incoming.

C. SINGLE PHASE TYPE PANEL BOARD MAIN CIRCUIT BREAKER OR SWITCH DISCONNECTOR is to be double-pole, with or without earth leakage device (RCD), as shown on the Schedules.

D. SINGLE-POLE + NEUTRAL (1 + N) AND DOUBLE-POLE (2P) MCBs for 240 V service, are to have trip ratings between 6 A and 50 A, with ICU (n)/ICS as required in the Schedules.

E. THREE PHASE TYPE PANELBOARDS are to be suitable for up to 415 V a.c. maximum service voltage, 3 phase and neutral, with MCBs on branch circuits and 4 pole switch disconnect or circuit breaker, main incoming, as shown in the Schedules or on the Drawings.

F. FOUR-POLE BRANCH CIRCUIT BREAKERS are to have trip ratings between 6A and 100A, with ICU/ICS as required in the Schedules.

G. THREE PHASE TYPE PANELBOARD MAIN SWITCH DISCONNECTOR OR CIRCUIT BREAKER is to be four-pole, with or without earth leakage device (RCD), as shown on the schedules.

H. SHORT-CIRCUIT RATING: THREE PHASE panelboards may only have an integrated equipment (series) short-circuit rating in accordance with calculations.

3. FIELD AND INSTALLATION WORK

3.1 INSTALLATION

A. FIXING GENERALLY:
- Align, level and securely fasten panelboards to structure
- Fix surface mounted outdoor panelboards at least 25mm from wall ensuring supporting members do not prevent flow of air.
- Do not use connecting conduits to support panelboards
- Close unused openings in panelboard cabinets.

B. PANELBOARD INTERIORS: do not install in cabinets until all conduit connections to cabinet have been completed.

C. WIRING INSIDE PANELBOARDS: to be neatly arranged, accessible and strapped to prevent tension on circuit breaker terminals. Tap-off connections are to be split and bolted type, fully insulated. Wiring shall be arranged on terminals and connection blocks with marking as indicated in section 16120 of the specifications.

D. TRIM: fix plumb and square prior to painting. Fix trim for flush mounted cabinets flush with wall surface finish.

E. PROTECTION: treat concealed surfaces of recessed cabinets with heavy field application of water-proof compound prior to installation.

3.2. INSPECTION AND TESTS ON SITE

A. GENERALLY: carry out sample tests, as required by the Engineer, on panelboards after installation, to verify short-circuit capability of circuit breakers and busbars. Inspect conditions within panelboards and verify insulation conditions by use of a megger.

B. CIRCUIT BREAKERS: tests are to include operation of every circuit breaker manually. Check automatic operation of selected circuit breakers, as required by the Engineer, by applying necessary short-circuit, overload and earth leakage current for tripping circuit breaker as applicable and compare with manufacturer's data/characteristic curves. Measure and report ambient temperature inside enclosure.

C. INSULATION CHECK TESTS: carry out insulation tests on all busbars, between phases and between phases and earth/cabinet, and between neutral and earth. Record all readings, using 500 V megger for equipment on 240 V systems, and 1000 V megger for equipment on systems up to 600 V, for 1-minute, with circuit breakers in open position.

D. ROUTINE TESTS ON SITE are to be carried out, in accordance with the Standards, on all panelboards assembled from standardized components of the manufacturer outside the works of the manufacturer.

CHAPTER 3
CONDUITS, WIREWAYS, SUPPORTING SYSTEMS AND RELATED ACCESSORIES

CHAPTER 3
CONDUITS, WIREWAYS, SUPPORTING SYSTEMS AND RELATED ACCESSORIES

1. GENERAL

1.1. ELECTRICAL WORK GENERALLY: is to be in accordance with the requirements of the chapter 1 of the Specification.

1.2. DESCRIPTION OF WORK: raceways including conduits, wireways, cable trays and related installations and accessories necessary to support and protect cables, feeders, branch circuit wiring and wiring of low current systems, communications and signal cables.

1.3. REGULATIONS AND STANDARDS: conduits, wireways, cables trays and fittings are to be designed, constructed and installed to give safe installation and reliable mechanical protection for wires and cables in accordance with the Regulations. Standards of products are to be as specified. Local production is prohibited if not tested and approved by a legal authority.

1.4. TECHNICAL DATA: submit data for approval including, but not limited to, the following:

A. Manufacturer's catalogues with specifications of raceways including conduits, trunking etc. and related accessories.

B. Samples of each type of raceway and accessory.

1.5. SHOP AND CONSTRUCTION DRAWINGS: submit drawings for approval including, but not limited to, the followings:

A. Exact routing of conduits, trunking etc. With indication of boxes, accessories and expansion joints, size of conduits and boxes

B. Typical assembly details of installation of trunking, trays etc.

C. Construction details of pull boxes.

D. Typical installation details including connection of conduits to metal enclosure. Connections of flexible conduits, vapour- tight installations in cold rooms, liquid tight flexible metallic outdoors etc. and earthing connections.

1.6. APPROVED MANUFACTURERS: obtain conduit, wireways and related accessories from one of the following or other equal and approved:

A. UNIVOLT (Austria)

B. EGA Tubes (England)

C. DIELECTRIX (England)

D. Siemens (Germany)

E. Simplex (England)

F. Decoduct (UAE)

2. PRODUCTS AND SYSTEMS

2.1. CONDUITS AND ACCESSORIES

2.1.1. RIGID & FLEXIBLE METAL CONDUIT

A. MATERIAL: steel, cold rolled and annealed, non-threaded type, formed from continuous length of helically wound and interlocked strip steel, with fused zinc coating on inside and outside.
Black enameled or hot dipped galvanized, L= 3m, screwed on both ends to NF-C-68-100. Locally manufactured conduits shall not be accepted.

B. LIQUID- TIGHT FLEXIBLE METALLIC CONDUIT: is to have PVC jacket extruded over core.

C. FITTINGS GENERALLY: thread less, hinged clamp type, hot dipped galvanized or cadmium plated malleable cast iron. Fittings used in corrosive atmospheres are to be specially treated.

D. STRAIGHT CONNECTORS: one piece body, female type, hot dipped galvanized or cadmium plated malleable cast iron. Fittings used in corrosive atmospheres are to be specially treated.

E. ANGLE CONNECTORS: of 45 or 90 degree and terminal connectors are to be as specified for straight connectors, except that body is to be two-piece with removable upper section.

2.1.2. RIGID MEDIUM GAUGE PVC CONDUIT.

A. MATERIAL: rigid un-plasticized, could form a bend with PVC accessories, polyvinyl chloride with high impact and high temperature resistance, flame retardant, non hygroscopic and non- porous, compressive strength $\geq$ 750 N, to CEE 26, BS 4607 and BS 6099, DIN 49026, NFC 68-107 or other equal and approved standards conforming to IEC 423.

B. FITTINGS GENERALLY: unbreakable, non-inflammable, self-extinguishing, moulded plastic.

C. ASSEMBLY: conduits, boxes and accessories are to be assembled by cementing, using manufacturer's recommended products and appropriate connectors or spouts are available use smooth bore male PVC bushes and sockets.

2.1.3. FLEXIBLE MEDIUM GAUGE PVC CONDUIT

A. MATERIAL: flame retardant, heat resistant, non-hygroscopic PVC, high resistance to impact, ribbed on circumference for flexibility.

3. FIELD AND INSTALLATION WORK

3.1. CONDUIT AND WIREWAYS GENERALLY

A. USE: unless otherwise specifically indicated all light and power circuits, communications, signal and low current systems wiring are to be drawn inside conduits or wireways up to the various electric power consuming equipment as shown on the Drawings. Separate conduit and wireways installations are to be used for LV cables/wires normal light and power circuits, emergency light and power circuits and communication, signal and other low current systems wiring.

B. BOXES: junction, pull and splice boxes of ample capacity are to be provided as indicated or required. Boxes are to remain permanently accessible.

C. TOOLS AND ACCESSORIES: for forming and installing conduit and wireway systems are to be purpose made for the particular application and used in accordance with manufacturer's instructions.

D. FIXING: conduits and wireway installations are to be concealed as much as possible.

E. SIZES: Unless otherwise specified conduits and wireways sizes, not shown on the Drawings, are to be selected in accordance with the tables on design drawings and in relation to the number and size of conductors. Minimum size of conduit for all applications is to be 20 mm diameter, unless otherwise shown on the Drawings.

F. MECHANICAL CONTINUITY: conduits and wireways are to be effectively joined together and connected to electrical boxes, fittings and cabinets to provide firm mechanical assembly. Earthing jumpers are to be installed on steel conduits where required to ensure effective electrical continuity irrespective of whether a protective earth conductor is required or not.

3.2. PVC CONDUITS

A. COUPLING OF CONDUIT and/ or termination into spouted fittings are to be made watertight and permanent using special cement.

B. TERMINATION: connect conduits terminating in switchgear, fuseboards, trunking, adaptable boxes or non-spouted enclosures etc, with smooth bore male PVC bushes and sockets.

C. ENDS OF CONDUIT end conduit fittings are to be cleaned and jointed using PVC cement recommended by manufacturer.

D. SEMI-PERMANENT ADHESIVE: use in joints requiring expansion couplers.

3.3. EMBEDDED CONDUITS

A. CONDUITS IN CONCRETE SLABS: place conduits parallel to main reinforcing steel.

B. CONDUITS IN PARTITIONS OR SIDE WALLS: horizontal or cross runs are to be avoided.

C. PULL-BOXES are not to be used. If unavoidable, pull-boxes may be approved if located inconspicuously.

D. CONDUITS IN FLOOR OF BEDS ON GRADE: encase in concrete, minimum thickness 50 mm or to thickness allowed by architectural detail.

E. PVC CONDUITS IN REINFORCED CONCRETE STRUCTURES are generally to be installed after placing reinforcement and before concreting, if protected against damage, or are to be placed in grooves in formed in the concrete, if approved.

3.4. EXPOSED CONDUITS

A. CONDUITS ON WALLS: run neatly, horizontally or vertically.

B. SUPPORTS: use approved clamps, hangers or clips fastened by machine screws to expansion sleeves in inserts or to lead anchors.

C. SPACING OF CLAMPS OR CLIPS for supporting steel conduits is not to be greater than:

Conduit Size mm (inches)	Maximum Spacing of Supports meters
20 (3/4)	1.5 m
25 (1)	1.5 m
32-38 (1-1/4-1-1/2)	2 m

D. SPACING OF CLAMPS OR CLIPS for supporting PVC conduits is not to be greater than.

Conduit Size mm (inches)	Maximum Spacing of Supports meters
20 (3/4)	0.60
25-50 (1-2)	0.75
63-75 (2-1/2-3)	0.90

E. BENDS AND FITTINGS: firmly fasten conduit at each side of bends and within 900 mm of each outlet box, junction box, cabinet or fitting.

F. OUTLETS: do not run more than one conduit to any surface wall outlet. Install junction box on home run near to ceiling level and tap-off vertical conduit to outlet box below.

CHAPTER 4
WIRING DEVICES AND DISCONNECTS

CHAPTER 4
WIRING DEVICES AND DISCONNECTS

1. GENERAL

1.1. **GENERAL WORK GENERALLY** is to be in accordance with the requirements of the chapter 1 of the Specification.

1.2. **DESCRIPTION OF WORK:** wiring devices, lighting switches, socket outlets, cord outlets, automatic and manual lighting control equipment, dimmers, outlet boxes and plates, disconnect switches etc.

1.3. **STANDARDS:** components are to be standard manufactured items, uniform and modular, complying with one set of approved Standards.

1.4. **EQUIPMENT DATA:** submit data for approval, including catalogues, detailed literature, manufacturer's name, catalogue number, rating, specification, overall dimensions and special features, as applicable for each item.

1.5. **SHOP AND CONSTRUCTION DRAWINGS:** submit drawings for approval including, but not limited to, the following:

A. Exact indication of position of each item and outlet box and fitting on layout drawings, with box and equipment types and sizes.

1.6. **SAMPLES:** submit samples of each type of device for approval, unless otherwise agreed in writing by the Engineer.

2. PRODUCT AND SYSTEMS

2.1. FITTINGS

2.1.1. OUTLET BOXES AND PLATES GENERALLY

A. SURFACE OR RECESSED BOXES are to be suitable for type of related conduit or cable system. Shapes and sizes of boxes are to be compatible standards as switches, socket outlets and lighting fixtures selected and of various types and mounting methods required.

B. UNUSED OPENINGS in outlet boxes are to be closed with knock-out closers manufactured for the purpose.

C. BLANK PLATES: blank plates are to be installed on outlet boxes on which no apparatus is installed or where apparatus installed does not have suitable cover for box. Blanks plates for wall outlets are to be attached by a bridge with slots for horizontal and vertical adjustment.

2.1.2. MOULDED PLASTIC OUTLET BOXES

A. TYPE: boxes and covers used with PVC conduit systems are to be heavy gauge pressure moulded plastic, minimum 2 mm thick, self extinguishing, with softening point not less than 85 deg. C. Boxes are to have provision for securely terminating conduits and are to be manufacturer's standard for required application.

B. FITTINGS: boxes are to have brass inset threads to receive cover screws and for mounting devices or accessories, push- fit brass earth terminals, and steel insert clips to provide additional support for pendants or for heat conduction. Neoprene gaskets are to be provided for weatherproof installations.

C. MANUFACTURERS: obtain moulded plastic outlet boxes from:
1. Egatube (England)
2. M.K. (England)
3. Legrand (France)
4. B Tichino (Italy)

Or other equal and approved.

2.1.3. SWITCHES

A. GENERALLY: quick- make, quick- break type with silver alloy contacts in arc resisting moulded base, with toggle, rocker or push- button as specified, for inductive or resistive loads up to full rated capacity, and arranged for side and/or back connection.

B. TYPES: single, two- way or intermediate, single pole or double pole, as shown on the Drawings.

C. GENERAL LIGHTING SWITCH: 10 A 220 V a.c., rocker operated, grid- switch with plastic plate, for indoor installations in general, unless otherwise indicated.
   1. Man: Legrand or other equal and approved.
      Ref: unless otherwise mentioned on drawings:
      One way one gang 74010
      One way greater or equal to two gang 74000

D. PUSH BUTTON SWITCH, Ref unless otherwise mentioned on drawings:
   One gang 74040
   Two or larger than 74030.

E. MANUAL SWITCH: 2 pole, for fractional single and three phase motors and appliances, to interrupt motor and induction loads, rated 20 A at 415 V a.c., toggle operated, with positive indication of on/off position of contacts.
   1. Man: Merlin Gerin or other equal and approved.
   2. Ref: [(15006 + 13392) when installed as one gang] for single phase, (15007 + 13392) for three phase (without Neutral) and (15008 + 13392) for three phase (with Neutral).

2.1.4. SOCKET OUTLETS

A. GENERALLY: to have injection moulded plastic base with self-adjusting, non-expanding contacts to prevent permanent distortion, arranged for side and/or back connection and with screw terminals accepting at least three parallel branch- circuit wires.

B. TYPES: general-purpose socket outlets are to conform with standard German practice concerning layout & rating).

C. DUPLEX SOCKETS are to be mounted in parallel under one common plate with break- off feature for two-circuit connection

D. WEATHERPROOF SOCKET OUTLETS are to be any of the types indicated, enclosed in surface mounted cast metal box and with cover comprising spring- retained gasketted hinged flap. Enclosure is to be pre- designed box and cover for type of socket outlet specified.

E. GERMAN STANDARD SOCKET: single phase, three wire for plug with 3 mm round pins at 19 mm centers, with grounding in accordance with standard German practice and rated 10/16 A, 250 V a.c.
   1. Man: Legrand or other equal and approved.
   2. Ref: 74130 (and 74132 for UPS).

2.1.5. PLUGS

A. TYPE: compatible with type of socket outlet specified, break resistant, of impact resistant moulded insulating material (separable construction), with solid brass pins and cord grip and of shape providing easy hand- grip for removal.

B. QUANTITY: supply number equal to 20% of total number of each type of socket outlet supplied.

2.1.6. SWITCH DISCONNECTOR (DISCONNECTING SWITCH)

A. RATING: 690 V, 2,3 or 4 pole, load break, short- circuit make, in accordance with IEC 947-3, utilization category 22 for heating and lighting loads, category 23 for motor circuits, and with ampere rating shown on the Drawings.

B. DESIGN: non- fusible, air- break switch disconnect, single throw, safety type, housed in separate metallic enclosure with arc quenching devices on each pole.

C. OPERATING MECHANISM: quick- make, quick- break, independent of operator, with external operating handle mechanically interlocked to prevent opening door unless switch is in open position. Switch disconnect is to have provision for by-passing interlock. Position of handle is to be positive and clearly indicated on cover.

D. ENCLOSURE: General purpose sheet steel for indoor use IP 42 and weather- proof type cast- metal or sheet steel for outdoor installations IP 65 IK 08, unless otherwise required or shown on the Drawings. Locking of operating handle is to be possible in open and closed positions.

E. MANUFACTURERS: obtain switch disconnect from one of the following of the following or other equal and approved:
   1. Merlin Gerin (France)
   2. Klockner Moeller (Germany)
   3. ABB (Germany)
   4. Siemens (Germany)
   5. Socomec (France)
   6. Legrand (France)

3. FIELD AND INSTALLATION WORK

3.1. INSTALLATION

A. LOCATIONS: the Drawings generally show approximate locations of outlets and equipment. Exact locations are to be determined from interior finishing and detail drawings. Any condition that would place an outlet in an unsuitable location is to be referred to the Engineer. Locate switches at strike sides of doors, whether shown on the Drawings or not. In locating outlets allow for overhead pipes, ducts, variations in arrangement, thickness of finishing, window trim, paneling and other architectural features.

B. MOUNTING HEIGHTS for outlet boxes and similar equipment are to be uniform within the same or similar areas. Mounting is to be as shown on the Drawings or as approved by the Engineer. Unless otherwise shown or instructed, mount lighting switches and socket outlets generally at 1200 mm and 300 mm from finished floor level respectively. Mount switches with long dimension vertical and operating handle, if of the toggle type, up when in the on position.

C. SINGLE POLE SWITCHES are to switch the phase wire. Do not run neutral wire through switches having neutral shunt or bridge.

D. ADDITIONAL OUTLETS to those shown on the Drawings are to be provided as required by equipment manufacturers for control or other wiring.

E. EXPOSED OUTLET BOXES: securely fasten to wall with machine screws to permanent inserts or lead anchors.

F. RECESSED OUTLET BOXES: make neat openings, to the satisfaction of the Engineer, allowing for thickness of finishing and use extension rings if required. Repair damaged finishing to original condition before installation of fittings or plates.

G. APPEARANCE: install exposed boxes and plates plumb, square and parallel to finished wall surface. Exposed plates covering recessed boxes are to rest neatly on wall surface without gaps, and fully covering the box.

H. GROUPED OUTLETS: arrange neatly so that use of fittings is convenient and clear.

I. WATERPROOF AND EXPLOSION- PROOF FITTINGS: follow manufacturer's instructions for installation and connection to conduit system to fully achieve required degree of protection.

J. DAMAGED FITTINGS: reject damaged fittings or plates with damaged finish. Protect fittings and plates against damage after installation and handed over.

K. CONNECTION OF APPLIANCE:
1. Where appliance is designed to adapt directly to outlet box, extend electrical wiring to incoming terminals inside appliance.
2. Where appliance is not designed to adapt to outlet box, install connecting wiring in flexible conduit firmly fixed to outlet box cover plate and to terminal box on appliance.

3.2. INSPECTION AND TEST ON SITE

A. VISUAL INSPECTION: fittings and equipment are to be inspected for fixing and workmanship.

B. MEGGER TESTS are to include switch and socket outlet tests together with insulation resistance of wiring installations.

C. OPERATION: devices are to be tested for operation and are to perform as intended at full load without any signs of heating.

D. EQUIPMENT is to be insulation tested and observed, under full-load for not less than 3 days operation, with respect to undue heating and performance in general.

CHAPTER 5
GENERAL LIGHTING INSTALLATION

CHAPTER 5
GENERAL LIGHTING INSTALLATION

1. GENERAL

1.1. ELECTRICAL WORK GENERALLY is to be in accordance with the requirements of the chapter 1 of the Specification.

1.2. DESCRIPTION OF WORK: complete indoor and outdoor lighting installations including fixtures, control gear, mounting provisions, accessories and connection to circuit wiring and to corresponding lighting control equipment.

1.3. FIXTURE DESIGN AND STANDARDS: the Specification and the Drawings are a guide to the selection of lighting characteristics and lighting fixtures, giving general features of construction, materials, method of installation and conditions of operation. Unless otherwise specified, fixtures are to be manufacturer's standard series, designed and manufactured for the purpose and application required, generally in accordance with the Schedule of Lighting Fixtures and complying with IEC 598 and CISPR 15.

1.4. DESIGN LAYOUT: fixture layout has been determined from photometric data of specified fixtures to achieve desired level and uniformity of illumination. Reflected ceiling plans are to be checked to ensure exact positions of fixtures with respect to structural members, ducts pipes, other installations and ceiling panels/tiles, where required.

1.5. EQUIPMENT DATA: submit data for approval including, but not limited to, the followings:

A. Detailed literature on each fixture, lamp and control gear including manufacturer's name, catalogue number, rating, material specification, overall dimensions, operating characteristics and principals.

B. Details of changes to standard fixtures for adaptation to condition of installation and to the Specification.

C. Photometric data for lighting calculations including polar light distribution curves, coefficient of utilization, glare classification, efficiency, depreciation factors etc.

1.6. SAMPLES: submit fully equipped sample of each fixture type, modified if required, together with color and texture samples of each fixture.

2. PRODUCTS AND SYSTEMS

2.1. COMPONENTS AND ACCESSORIES

2.1.1. LIGHTING FIXTURE CONSTRUCTION-GENERAL

A. GENERALLY: construction and wiring of fixtures are to comply with the Regulations and Standards. Fixtures are to be fabricated, assembled and wired entirely at factory. Manufacturer's name, factory inspection stamp and official quality label are to be fixed to each fixture supplied.

B. LIGHTING FIXTURES (LUMINAIRES): to be manufacturer's standard, as given in Lighting Fixture Schedules shown on the Drawings, or equal.

C. SHEET STEEL HOUSINGS: to be not less than 0.6 mm thick, and thicker when required by the Specification or the Standards.

D. SHEET STEEL REFLECTORS: to be not less than 0.5 mm thick.

E. ALUMINUM REFLECTORS: to be not less than 0.7 mm thick, unless otherwise approved.

F. FABRICATION: metalwork is to be mitred, welded and ground smooth without tool marks or burrs. Flat metal parts are to be stiffened by forming grooves and edges during fabrication. Metal parts are to have finish free from irregularities.

G. RUST-PROOF FERROUS BASE: ferrous metal parts are to be bonderized (treated with corrosion resistant phosphate solution) and given an approved rust-inhibiting prime coat before application of final finish.

H. FINISH FOR NON-REFLECTING METAL SURFACES: approved baked enamel paint. Paint color on fixture frames and trims is to be as specified or as selected by the Engineer.

I. FINISH FOR LIGHT REFLECTING SURFACES: white baked enamel paint having reflection factor not less than 85%. Mirror reflectors, where specified, are to be highly polished, anodized aluminum with reflection factors not less than 97%.

2.1.2. LIGHT EMITTING DIODE (LED) LAMPS AND FIXTURES

A. All LED light engines (combination of diodes, driver, heat sink, housing and optics), whether screw-in or hardwired, shall meet all of the following criteria:

- The rated driver input wattage and total number of LEDs shall be published by the manufacturer for each Fixture.
- All equipment must have model-identification that is specific and clear enough to accurately match installed equipment with equipment submittals and specific product entries in the qualification lists referred to below.
- LED Fixtures must be on one of the approved lists mentioned and must carry a safety certification by an approved testing laboratory (UL, CE, ETL, etc.).

B. Provide lighting fixtures in accordance with the Fixture Schedule.

C. Provide only LED fixtures with a Design Lights Consortium (DLC) listing, a U.S. Department of Energy (DOE) “LED Lighting Facts” label, or a U.S. Environmental Protection Agency (EPA) ENERGY STAR label, which have demonstrated third-party testing verification.

D. Recessed lighting fixtures shall be thermally protected.

E. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers. User serviceable LED lamps and drivers shall be replaceable from the room side.

F. Dimmable LED fixtures shall have either a 0-10 volt, 3-wire dimming driver, or a two-step (50%-100%) line voltage, two switch controlled dimming driver, as shown on the drawings.

G. LED lamps shall have a color temperature of 3500 - 6500 degrees K, a CRI of 80 minimum, and a lumen maintenance L70 rating of 30,000 hours minimum.

H. Retrofit LED lamps shall comply with NEMA SSL 4 “SSL Retrofit Lamps: Suggested Minimum Performance Requirements”.

I. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 “Electronic Drivers for LED Devices, Arrays, or Systems”. LED drivers shall have a sound rating of “A”, have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.

J. Dimmable LED drivers shall be 0-10V type. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.

3. FIELD AND INSTALLATION WORK

3.1. INSTALLATION

A. GENERALLY: install fixture level, aligned and parallel or square to building lines and at uniform heights as shown on the Drawings or as approved by the Engineer. Make final height adjustment after installations.

B. FIXTURE SUPPORT: provide fixture and/or fixture outlet boxes with hangers, brackets and flanged bolted fittings, as necessary, to support weight of fixture. Submit details of hangers etc. and method of fastening for approval. Rigidly secure fixture mounted on outlet boxes to fixture studs. Install hooks or extension pieces, when required, for proper installation. Provide one point of support in addition to the outlet box fixture stud for individually mounted fixtures longer than 600 mm.

C. SUSPENDED CEILINGS: if ceiling construction is unable to support weight of fixtures without strain or deformation, suspend fixtures directly from building structure.

D. SOLD CEILINGS: coordinate dimensions of recesses in ceilings with exact fixture dimensions and structural elements.

E. CONTINUOUS ROWS: arrange fixture so that individual fixtures can be removed without dismantling remaining fixtures. Provide minimum spacing between fixtures.

F. COVER PLATES: install cover plates over fixture outlet box or opening in ceiling or structure when left unused.

G. FLUSH RECESSED FIXTURES: install to completely eliminate light leakage within fixture and between fixture and adjacent finished surface.

H. VENTILATION: keep ventilation channels free after fixture is installed, if required by the design of the fixture.

I. EARTH metal frames of fixtures as described in Section 219 of the Specification.

J. TIGHTNESS: ensure that enclosed fixtures are reasonably insect/ dust tight when installed, and completely weather-proof for installations subject to weather conditions.

K. LAMPS FOR PERMANENT INSTALLATION: place new lamps in fixtures immediately prior to hand-over and when instructed by

the Engineer. Lamps used for temporary service are not to be used for final lamping of fixtures.

3.2. INSPECTION AND TESTS ON SITE

A. VISUAL INSPECTION: check neatness of installation, uniformity of equipment and nameplates etc.

B. ILLUMINATION MEASUREMENTS: to be taken at selected locations, to determine level and uniformity.

C. OPERATION: check lighting installations for operation including control and regulation equipment.

D. ELECTRICAL DATA: measure power factor, current and voltage at start for installations with discharge lamps.

CHAPTER 06
EARTHING SYSTEM

CHAPTER 06
EARTHING SYSTEM

1. GENERAL

1.1. ELECTRICAL WORK GENERALLY is to be in accordance with the requirements of the chapter 1 of the Specification.

1.2. DESCRIPTION OF WORK: complete installations to earth every source of energy and to provide protective earthing and equipotential bonding, based on the TN-S system arrangement, including:

A. Main earthing system.

B. Main earthing terminals or bars.

C. Electrical room earthing terminal.

D. Exposed conductive parts of electrical equipment.

E. Extraneous conductive parts.

F. Standby generators earthing terminal.

1.3. REGULATIONS AND STANDARDS: carry out work in accordance with the following:

A. IEC publications 364-3 and 364-41 Electrical installations in Buildings.

B. Latest edition of NFC 15-100 Regulations.

1.4. DEFINITIONS OF TERMS used on the Drawings and in the Specification are as follows:

A. EARTH: conductive mass of the Earth whose electric potential at any point is conventionally taken as zero.

B. EARTH ELECTRODE: conductor or group of conductors in initial contact with, and providing electrical connection to, Earth.

C. EXPOSED CONDUCTIVE PART: any part which can be readily touched and which is not a live part, but which may become live under fault conditions.

D. MAIN EARTHING TERMINAL OR BAR: the terminal or bar provided for the connection of protective conductors, including equipotential bonding and functional earthing conductors if any to the means of earthing.

1.5. EQUIPMENT DATA: prior to ordering materials, submit data for approval including, but not limited to, manufacturer's catalogues for earth rods, connecting clamps, earthing conductors, protective conductors, bonding conductors, connectors and other accessories, exothermic welding kits and tools etc., and samples of samples conductors as requested.

1.6. SHOP AND CONSTRUCTION DRAWINGS: submit drawings for approval including, but not limited to, the following:

1. Exact location of earth pits, rods and details of installation and connection.

2. Exact routing of buried earthing conductors with indication of cross-section, depth of laying and covering.

3. Cross sectional area of all earthing, protective and bonding conductors

4. Layout and details of earthing provisions at substations, generator rooms, switchgear, distribution panelboards etc., indicating fittings used, insulation, plates and marking, passage and routing of earthing conductors, conduit, sleeves, grooves, niches etc., giving sizes and dimensions of component parts.

1.7. APPROVED MANUFACTURERS: obtain materials from one of the following:

A. BICC (England)

B. Copperweld (U.S.A.)

C. Furse (England)

D. G.E.C. (England)
or other equal and approved.

2. PRODUCTS AND SYSTEMS EARTHING SYSTEM (TYPE TN-S)

2.1. GENERAL REQUIREMENTS

A. COMPONENT PARTS of earthing system are to include the following:

1. Earth electrode (rods, tapes etc.)
2. main earthing terminals or bars
3. Earthing conductors
4. protective conductors
5. Equipotential bonding conductors
6. electrically independent earth electrodes for special systems with transient earth clamp (similar to ERICO TEC 100C) for connection to standard earthing electrodes (Following the recommendation of the NFC 15-100 with this respect.)
7. Accessories and termination fittings, bonding, welding kits and other materials.

B. EARTH ELECTRODE is to consist of one or more earth rods, interconnected by buried earthing tape or cable, which is to have a total combined resistance value, during any season of the year and before interconnection to other earthed systems or earthing means, not exceeding 3 ohm other wise use additional earth rods. Distance between two rods is not to be less than twice the length of one rod driven depth.

C. FUNCTIONAL EARTH ELECTRODE is to be provided separately from, but interconnected to general bus collecting all the earth at the building and to other earth electrode (s) through suitably rated (470 V) spark gap. Functional earth electrodes are to be used for earthing electronic equipment (communication equipment, digital processors, computers etc.) as required by the particular Section of the Specification and recommendation of manufacturer.

D. ALTERNATIVE EARTH ELECTRODE: other types of earth electrode may be used, after approval, including:

1. Cast iron pipes with special surround material

2. Copper plate (s)

3. Tape mats (strips)

4. MAIN EARTHING BAR is to be provided at point of service entrance or main distribution room, and as described in the Specification or shown on the Drawings, to which all earthing conductors, protective conductors and bonding conductors are to be connected. Two insulated main earthing conductors are to be provided, one at each end of the bar, connected via testing joints to the earth electrode at two separate earth pits. conductor is to be sized to carry maximum earth fault current of system at point of application with final conductor temperature not exceeding 160 deg. C for at least 5 seconds. Main earthing conductors are to be minimum 95 mm2 bare copper conductor or as otherwise required by the particular Section of the B.O.Q.

5. TESTING JOINTS (TEST LINKS) are to be provided, in an accessible position, on each main earthing conductor, between earthing terminal or bar earth electrode. A bus system shall allow the disconnection of the lightning earth cable from the other earth cable in order to provide a separate test for each earth.

6. PROTECTIVE CONDUCTORS are to be separate for each circuit. Where protective conductor is common to several circuits, cross-sectional area of protective conductor is to be the largest of the conductor sizes. Unless otherwise mentioned the selection of sizes is to be in accordance with Table 54F of IEE Regulations.

7. PROTECTIVE CONDUCTORS are not to be formed by conduit, trunking, ducting or the like. Where armored cable is specified and armour is steel, it may be used as a protective conductor, if approved and if not otherwise shown on the Drawings.

8. CONTINUITY OF PROTECTIVE CONDUCTORS: series connection of protective conductor from one piece of equipment to another is not permitted. Extraneous and exposed conductive parts of equipment are not to be used as protective conductors, but are to be connected by bolted clamp type connectors and/ or brazing to continuous protective conductors which are to be insulated by moulded materials.

9. MAIN EQUIPOTENTIAL BONDING: main incoming and outgoing water pipes and any other metallic service pipes are to be connected by main equipotential bonding conductors to main earth terminal or bar. Bonding connections are to be as short as practicable between point of entry/exit of services and main earthing bar. Where meters are installed, bonding is to be made on the premises side of the meter. Cross-sections of conductors are not to be less than half of the earthing conductors connected thereto, and minimum 6 mm2.

10. IDENTIFICATION: connection of every earthing conductor to earthing electrode and every bonding conductor to extraneous conducting parts is to be labelled in accordance with the Regulations, as follows:

11. SAFETY ELECTRICAL CONNECTION- DO NOT REMOVE.

12. IDENTIFICATION: protective and earthing conductors are to be identified by combination of green- and - yellow colours of insulation or by painting bar conductors with these colours, as approved.

13. IDENTIFICATION: source earthing conductor is to be identified along its entire length by continuous green/yellow insulation labelled ‘earthing’.

2.2. EARTHING OF MAIN DISTRIBUTION BOARDS, PANELBOARDS, LIGHTING INSTALLATIONS AND WIRING ACCESSORIES

A. MAIN EARTHING BAR is to be provided in location mentioned on drawings and connected to earth network by insulated conductor (size as mentioned on drawings) via testing joints.

B. DISTRIBUTION, LIGHTING AND POWER PANELBOARDS are to be connected by protective conductors run together with incoming feeder cable, connecting earth terminals in panelboards with respective main building earthing bar.

C. SOCKET OUTLETS are to be earthed by protective conductor looped around with the branch circuit and connected to earth terminal within socket outlet box and to which socket outlet terminal is to be connected.

D. LIGHTING FIXTURES AND OTHER EXPOSED CONDUCTIVE PARTS of electrical installations, such as switches, heaters, air conditioning units etc. are to be connected by protective earth conductors to earthing terminals of respective panelboards.

2.3. MATERIALS AND PRODUCTS

A. EARTH ROD: copper clad steel, 20 mm diameter, 1.2 m length, extendible as necessary (minimum 2) to obtain required earth resistance. Earth rod is to be complete with couplings, head and bolted connector of sufficient size, and number of bolted clamps to connect all cables terminated thereto.

B. BURIED EARTH CONDUCTORS: annealed copper conductors 95 mm2 cross-section.

C. TAPS MATS: where earth rods are not likely to be used, earth electrode is to consist of parallel and perpendicular copper strip, 2.4 m apart, welded together by exothermic welds to form a grid. Tape is to be 25x25 mm strip conductor.

D. EARTH PIT: pre-cast, square or circular section concrete hand-hole (minimum 450 mm internal diameter), with concrete cover, and extending to about 150 mm below top of earth rod. Earth pit is to be provided for each earth rod where connected to an earthing conductor. Cover is to have inset brass plate with inscription ‘Earth pit-Do Not Remove.

E. EARTHING CONDUCTORS: insulated (green/yellow) or bare copper conductor as described in the Specification for the particular application.

F. TESTING JOINTS (TEST LINKS): copper or copper alloy, with bolted end connections, disconnectable by use of a tool, and suitably sized for earthing conductors or earth bar connection. Links are to be fixed to porcelain or other approved insulating supports. Contact surfaces are to be tinned.

G. PROTECTIVE CONDUCTORS: single core stranded annealed copper, PVC insulated cables, having rated insulation grade compatible with circuit protected, or to be a conductor forming parts of a multi-core cable, colour coded.

H. MAIN EARTHING BAR: hard drawn copper, 40x4 mm where formed into a closed loop, and 50x6 mm where open ended. Earth bar is to be labelled Main Earth Bar and is to be drilled, for connection of conductors, at a spacing not less than 75 mm, and is to be supplied with copper alloy bolts, nuts and washers and wall mounting insulators.

I. PROTECTIVE BONDING CONDUCTORS: bare copper strip conductor, annealed stranded copper cable or flexible strap (flexible braid) of cross- sectional area as described in sub-section 1 hereof.

J. EARTHING ACCESSORIES: copper or copper alloy, purpose made, of approved design, compatible with points of connection, and of adequate cross- section and current carrying capacity. Connectors and clamps are to be bolted type. Bolts, nuts and washers are to be high quality phosphor bronze or copper silicon alloys.

3. FIELD AND INSTALLATION WORK

3.1 INSTALLATION

A. CONTINUITY: ensure that complete earthing system is electrically continuous and mechanically secure.

B. EARTH RODS: while siting earth rods, ensure that resistance areas associated with individual rods do not overlap. Earth rods are to be located at a distance greater than 600 mm from foundations of buildings. Where rocks are encountered, a hole of sufficient size is to be drilled before lowering the rod. Conductive filler such as Marconite or Bentonite or equal filler that will not corrode, is to be provided around the rod.

C. BURIED EARTHING CONDUCTORS are to be laid at a depth not less than 0.8 m from ground surface.

D. EARTHING CONDUCTORS are to be following shortest path between earth rods and main earthing terminals or bars, and are to run in PVC conduit (duct) fastened to building structure by approved supports and extending 0.2 m above level, and are to be protected against mechanical damage and corrosion.

E. PROTECTIVE CONDUCTORS: separate protective conductors, which are not part of a cable, are to be fixed on same support or drawn into same conduit as circuit conductors.

F. PROTECTIVE BONDING: remove any non-conductive paint, enamel or similar coating at threads, contact points and surfaces and ensure that bonding is made by fittings designed to make secure bonds.

G. PROTECTION AGAINST CORROSION: protect bolted connections against corrosion either by filling with Vaseline or coating with a special anti-corrosion compound and proper capping.

H. CONNECTIONS: earth connections are to be readily accessible. If inaccessible earth connection is permitted, approved exothermic welding or brazing technique is to be employed.

I. CONNECTIONS: where earth connections between dissimilar metals must be made, use bimetallic fittings and protect by coating with moisture resisting bituminous paint or compound, or by wrapping with protective tape to exclude moisture.

UNITED NATIONS

DEVELOPMENT PROGRAMME
LEBANON

PROFESSIONAL SERVICES FOR THE DESIGN AND SUPERVISIONS OF REHABILITATION AND CONSTRUCTION PROJECTS ON LONG TERM AGREEMENT (LTA) basis

Ref.: LEB/CO RFP/11/17

Construction of a Homemade Food Market in Anjar

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PART 2
MECHANICAL ENGINEERING SERVICES

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CONSTRUCTION OF A HOMEMADE FOOD MARKET ANJAR – LEBANON

VOLUME 2
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PART 2
MECHANICAL ENGINEERING SERVICES

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1.0 GENERAL TECHNICAL REQUIREMENTS

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CHAPTER ONE
GENERAL TECHNICAL REQUIREMENTS

1. SCOPE, REGULATIONS AND STANDARDS

Specification Scope

This Specification covers the supply, installation and testing of all necessary equipment required for the complete Mechanical and Ventilation Services as described in the attached Contract Documents and incorporates standard descriptions for equipment and the installation to be provided under this Contract. The clauses shall be read in conjunction with the accompanying General Conditions of Contract, Scope of Works document, Schedules and Drawings.

The words 'as indicated', 'where indicated', 'unless otherwise indicated', refer to requirements identified elsewhere in the documents issued in connection with the Contract, e.g. on a drawing, in the specification or in a schedule.

The extent of the work shall comprise the system engineering, the whole labour and materials required to form a complete installation, together with such tests, adjustments and commissioning as prescribed in subsequent clauses and otherwise as may be required in order to provide an effective working installation to the satisfaction of the Engineer.

The words 'complete installation' in the foregoing clause shall mean not only the major items of plant and equipment covered by this Specification, but all the incidental sundry components that are required for the complete execution of the works; also for the proper operation of the installation, together with associated labour charges, whether or not these sundry components are mentioned in detail in the tender documents issued in connection with the Contract.

The Contractor shall comply with the latest applicable Standards of the followings:

1) ASME , American Society of Mechanical Engineers.
2) ASHRAE, American Society of Heating , Refrigerating and Air Conditioning Engineers, Inc.
3) ANSI, American National Standards Institute.
4) CIBSE, Chartered Institute Of Building Services Engineers.
5) ASTM, American Society of Testing Materials.
6) AMCA, Air Moving and Conditioning Association.
7) NEMA, National Electrical Manufactureres Association.
8) NFPA, National Fire Protection Association.
9) BS, British Standards
10) ASPE, American Society of Plumbing Engineers.
11) DIN Deutsches Institut Für Normung
12) FM, Factory Matual.
13) IBR, Institute of Boiler and Radiator Manufacturers
14) ISO, International Standardization Organisation.

Compliance with Regulations

The work shall comply with all relevant stringent statutory instruments and regulations, applicable to local codes and regulations, at the date of construction and in particular with the following:-

The requirements of the Local Authority Planning Department, District Surveyor or equivalent.

The requirements of the Local Fire Officer.

The Local Water Authority Regulations.

All installations and materials used for the works shall be carried out and provided in full compliance with the appropriate Specifications or Codes of Practice issued by the above mentioned institutions.

Alternatively the installations and materials may be carried out and provided to other equivalent internationally recognized standards provided the standards are acceptable to the Engineer and the relevant local Authorities.

2. INSTALLATION GENERAL

General

The Contractor shall allow in his Tender for all labour, materials, tools, plant and equipment required to supply, deliver and erect all equipment, pipework, fittings, etc., described in this Specification and indicated on the drawings to form a complete working facility including tests and commissioning. This shall mean not only the main items of plant and equipment but also all incidental sundry components with their labour charges necessary for the complete execution of the works.

The Contractor shall ensure that his work is installed in the correct sequence.

The Contractor shall be responsible for ensuring that all sections of the work and all materials are compatible with one another. The Contractor shall check and ensure that all of the equipment and works offered by him will fit into the space provided in the building(s) including the limited entry through doorways and into ducts.

Operating Conditions

All equipment will be required to operate successfully in the climatic conditions prevailing in the locality. Equipment, even if normally operating in air conditioned spaces, may be required to operate at times when the air conditioning system is not being used. Under such conditions all equipment must operate satisfactorily and still have a working life comparable with that expected from top quality equipment operating in more temperate conditions.

Workmanship and Materials

Materials and workmanship generally shall be of the highest standard and the Specification shall be closely adhered to. Materials shall be brand new bearing stamped ratings as required.

Where materials or equipment are not described in detail they shall be of the best quality available and shall comply with the appropriate Standards. The Contractor shall, if required, submit drawings or samples of such materials or equipment to the Engineer for his approval before use on the Contract works.

Samples of Workmanship

The Contractor shall provide the following samples of workmanship for the approval of the Engineer:-

Samples of pipework.

The samples shall be submitted to the Engineer as soon as possible after the order for the work has been placed so that the subsequent delivery of the associated equipment will not be delayed. No orders shall be placed until the Engineer has approved the samples.

All samples shall be correctly labelled and forwarded to the Engineer's office or to the site as directed by the Engineer. At least 14 days shall be allowed for approval of samples by the Engineer.

Unless otherwise stated, approved samples shall be retained on site by the Engineer, who will reject all such materials, which do not correspond with the approved samples. Rejected materials shall be removed from the site immediately.

Where the Engineer carries out an inspection of materials before they leave the manufacturer's premises prior to being delivered to the site, the Engineer shall be at liberty to reject any such materials after delivery should he consider them to be in any way unsatisfactory notwithstanding the preliminary inspection and tests at the manufacturer's premises.

The Contract shall include for the cost of remedial work or tests and inspections necessary due to unsatisfactory material and/or equipment.

3. NOISE AND VIBRATION CONTROL

Anti-Vibration Mountings

All equipment containing moving parts generating noise and vibration shall be mounted upon specially designed vibration isolators. All service connections to such equipment shall include customised flexible connectors and shall be installed in such a way as to prevent transmission of noise and vibration to the structure, other areas of the building or to other items of equipment.

Where required, mountings shall be provided with a positioning or restraining device, which will prevent the equipment position changing if its load changes, for example, during draining down of the equipment, or other maintenance.

Mounting selection should allow for any eccentric load distribution or torque reaction, so that the design deflection is achieved on all mountings under operating conditions.

4. INSPECTION, TESTING AND COMMISSIONING

General

All the works provided as part of this contract shall be inspected, tested, regulated and commissioned in accordance with all relevant Standards, Specifications and Codes of Practice and the details given in the specification and/or as indicated on the drawings, to the entire satisfaction of the Engineer.

All installations shall be inspected and tested in sections as the work proceeds and on completion as composite systems and it shall be noted that the Engineer may require to inspect or test any equipment during manufacture at the manufacturers works. All necessary arrangements shall be made as part of this contract.

All tests shall be arranged in co-operation with the Engineer and the Engineer and other interested parties shall be given seven (7) days notice in writing of the time, location and nature of the test to be performed. No test shall be considered valid unless the Engineer is present.

All necessary skilled and unskilled labour shall be provided for attendance duties during the test (including pre and post test activities) and the test medium shall be provided and subsequently disposed of except where specifically stated otherwise.

Any defects occurring at any time during the test duration shall be made good and a complete re-test shall be carried out, all at no cost to the contract.

Where failure during a test, inspection or commissioning process results in damage to the building fabric and/or any services or requires subsequent builderswork in connection to be carried out, then the remedial work shall be carried out at no cost to the contract.

Where valve and flange boxes and access covers and de-mountable ceilings need to be removed and replaced during the commissioning of the works, these shall be removed, protected from damage and replaced in good order by the Contractor.

The Contractor shall arrange a progressive regulation testing and balancing programme to achieve the Date of Completion of the Contract Works.

During the Commissioning Period the Contractor will hold commissioning meetings, which will be attended by the Engineer. The Senior representative of the Contractor's site and Management staff shall attend the meetings which will be held at fortnightly intervals.

The meetings may continue after issue of the 'Taking Over Certificate' for as long as necessary to deal properly with any outstanding works and defects in the Contract Works.

All representatives present during inspection, testing and commissioning shall be fully conversant with the system concerned and the method of system and instrument operation. Manufacturers or specialist contractors representatives shall attend where specifically indicated elsewhere in the Specification or where necessary to ensure full service and co-operation is available to the Engineer to enable the works to be tested and commissioned in accordance with the requirements of the Specification.

All necessary precautions shall be taken to safeguard against frost damage during inspection, testing or commissioning. Any damage so caused shall be made good at no cost to the contract.

All tests shall last for the minimum time period stated or for a longer period if necessary to ensure all sections have been fully examined as required by the test.

All performance tests shall be carried out initially prior to the Engineer being requested to witness the tests and thereby avoid unnecessary re-tests being required.

Provision of Test Points:

The Bills of Quantities do not separately enumerate test point in pipework and ductwork installations. These are deemed to be included in the pipework or ductwork installation. The Contractor shall allow sufficient points for the correct and complete regulation, testing, and commissioning of the installations. All test points shall be indicated on the Working and Record Drawings.

All test points shall be provided which are necessary to carry out the specified tests and commissioning requirements including facilities for temperature, pressure, pressure drop, volume flow, and other relevant conditions to be measured. Such points shall be fitted with removable plugs, flanges or other approved devices appropriate to the service concerned. Permanent test or reading points shall be provided only where specified elsewhere.

Provision of Regulating Valves and Dampers:

Balancing valves and dampers shall be included on every main, branch and sub circuit to facilitate system commissioning. All such devices shall be identified on the Working drawings and submitted for approval.

Testing of Soil, Waste, Vent and Rainwater Pipework

All works which are to be concealed shall be tested before being finally enclosed, a final test shall be made upon completion for soundness and performance strictly in accordance with the British Standard 5572 for Sanitary Pipework, or equivalent and shall be to the entire satisfaction of the Engineer.

Cleaning and Flushing Out of System

Prior to setting systems to work all systems shall be thoroughly cleaned and pipework systems shall be flushed out.

Water installations shall be flushed out using cold water at maximum mains pressure.

Steam and gas installations shall be thoroughly scavenged with steam or compressed air.

During the cleaning process the flow shall be interrupted occasionally to dislodge debris.

Tanks and vessels shall be similarly cleaned.

Water services for domestic use shall then be chemically cleaned by Chlorine treatment as described elsewhere, tested and set to work to comply fully with the UK Department of Health Code of Practice on the Control of Legionellae, and any other recognised recommendations to prevent the development of legionellae bacteria.

All cleaning and flushing out operations shall be conducted in the presence of the Engineer.

Following the cleaning and flushing out operations a signed certificate shall be provided confirming that the systems have been adequately and satisfactorily flushed through and cleaned. This certificate shall be countersigned by the Engineer and forwarded to the Engineer. No commissioning whatsoever shall take place until the Contractor has received written acknowledgement of receipt of this certificate from the Engineer.

Commissioning of Services

All systems shall be filled with the working fluid, vented as necessary, and brought to operating conditions and the flows then regulated to the design values.

The balancing and testing of systems to verify performance of the engineering systems shall be carried out by a team of experienced specialist Balancing and Testing Engineers who shall be responsible to the Contractor for the complete balancing and testing of all systems and the production of a complete log of all tests including any comments they may wish to make for improving the performance of the installations.

Following regulation and balancing procedures all plant systems shall be put into operation and examined to ensure that the installations are operating correctly.

5. HANDOVER PROCEDURES AND DOCUMENTATION

Operation and Maintenance Instruction Manuals

Three copies of a manual, (or series of manuals if required by the extent of the installations) shall be provided 1 month prior to the anticipated completion date of the contract and shall contain complete operational and maintenance instructions for the various installations.
The purpose of the manuals is to:-

(a) Familiarise maintenance staff with the overall philosophy of the project.

(b) Describe the Mechanical and Public Health Services systems and their inter-relation with other systems.

(c) Act as central point of reference and as such, to contain specific references to Record Drawings and Vendors/ Manufacturers literature to enable the reader to easily locate further information.

(d) Give all the specific information and instructions including safety information, to enable an operator, of technician level, to manually start and run each system at Local Control Station and from any Central Monitoring Control Station included in the Contract. This shall also include procedures for start-up of systems after an emergency shutdown.

(e) To give details of action to be taken by operators in event of fire, plant malfunction or alarm condition occurring.

(f) Provide information and warnings necessary to ensure the health and safety of the general public together with operating and maintenance staff.

The manual(s) shall be agreed in draft form with the Engineer and shall be primarily sub-divided into (a) instructions relevant to items of plant or equipment and (b) instructions relevant to complete systems.

The plant and equipment section shall contain the manufacturers printed maintenance and operator's instructions relevant only to the particular item of equipment concerned. General catalogues will not be acceptable.

The section dealing with complete systems shall be sub-divided into each service with a ready means of reference and detailed index. The function and manner of operation of each system shall be clearly described together with illustration and line diagrams in schematic form showing the location and function of control valves, items of equipment and which spaces or areas are served by these items. The colour coding and identification systems employed shall be explained, and a full lubrication schedule for all lubricated items of plant and equipment shall be included.

Operation and Maintenance charts shall be included for each plantroom area and shall provide essential information and reference data for daily running checks together with weekly, monthly and annual maintenance procedures.

Where more than one system can be shown on a single chart without loss of clarity this will be acceptable. Complex systems must be shown on individual charts.

A special section shall be included in the manual for dealing with fault finding routines and emergency procedures in case of plant or system malfunction.

All equipment shall be scheduled in the document including a complete valve schedule with all items identified in accordance with the plant reference provided on the item of plant or equipment and the as-installed drawings.

A complete itemised list of essential and secondary spares together with the manufacturers ordering reference numbers shall be provided. A list of plant manufacturers names, addresses and telephone numbers shall also be included.

The Operation and Maintenance manual(s) shall include copies of all manufacturers works test certificates for plant items such as heat generating plant, heat exchangers, calorifiers, refrigeration machines, tanks, vessels, motors, fans, pumps, controls, electrical and other like equipment. In the case of fans and pumps copies of the manufacturers characteristic curves for the actual unit fitted shall be supplied.

Labels and Identification

All valves controlling mains and sub-circuits shall be provided with a treffolyte label not less than 75mm x 50mm x 1.6mm thick with a reference number clearly engraved and coloured red. Labels shall be securely fixed to the valve body, handle or spindle in a position where they can be easily read.

The numbers on the valve labels shall refer to those on the "as installed" drawings and valve charts.

All items of plant, motor starters and isolators shall be labelled with their corresponding plant reference engraved on a treffolyte label securely fixed to the item in a prominent position. The plant reference shall correspond to that indicated on the "as installed" drawings and plant schedules in the operation and maintenance manuals.

In addition items of plant such as fans, pumps, calorifiers, etc. shall bear a metal label fixed by the manufacturer giving the makers name, date of manufacture and manufacturer's serial number, test and working pressures, duty, kW, phasing, hertz, speeds, BS number, etc. as appropriate to the item of plant such that its origins and details may be easily traced at a later date.

Schedule of Outstanding Items and Defects

Until the installation is finally taken over as complete, the Contractor shall be responsible for any necessary protection of the installation and electrical safety requirements.

On the completion of the Contract an inspection of the installation will be made by the Engineer. During the inspection a schedule of outstanding items or defects will be provided by the Engineer.

All items included in this Schedule shall be attended to within fourteen days of the date of the inspection.

Certificate of Practical Completion

When the Contractor has demonstrated to the Engineer and to the Engineer's complete satisfaction that the works are operating as intended within the design limits and tolerances of the manufactured items, then the Engineer will issue a Certificate of Practical Completion subject to the clearance of any outstanding items or defects within 14 days of the date of the Certificate and the responsibility for the operation of the plant will pass from the Contractor to the Employer or as otherwise agreed with the Engineer.
This Certificate will not be authorised until all items in this clause have been cleared to the Engineer's satisfaction.

Responsibility During Period of Maintenance

The Contractor shall include for making checks of the Thermal Environment in the building when occupied and in use by the Client and for making normal adjustments to the commissioning and testing settings to tune the installations to the actual building usage.

The Contractor shall include for making checks of the water flow capacities on domestic water services in buildings when occupied and used by the Client and for making normal adjustments to the commissioning settings to tune the installation to the actual building usage.

Testing of Plant Capacity and Efficiency

A heating test shall be carried out under maximum load and design conditions to check the actual plant capacity as supplied and installed. Where possible, thermal efficiency checks shall be made. These tests shall be carried out during the year following practical completion.

Adjustments During Course of Period of Maintenance

The Contractor shall include for making a further visit to the site before the end of the Period of Maintenance to check over and, if necessary, re-adjust the system.

Certificate of Making Good Defects

The Contractor shall carry out a thorough detailed examination of the installations between the eleventh and twelfth month of the defects liability period and shall put right any outstanding works or defects that might have occurred under the Defects Liability Period in the Conditions of Contract.

On completion of such works, and agreement that the requirements of the Conditions of Contract and Specification have been met, the Engineer will recommend to the Architect that a Certificate of Making Good Defects can be issued.

CHAPTER TWO
BELOW GROUND DRAINAGE

2.0 BELOW GROUND DRAINAGE

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CHAPTER TWO
BELOW GROUND DRAINAGE

1. GENERAL PREAMBLE

Description of Works

The belowground drainage shall comprise a separate system of drainage as described herein.

Where drainage is located beneath the building ground floor slab the pipe work shall be suspended from the underside of the concrete slab, where located externally pipe work shall be below ground installed in trenches as described.

Scope of Work

The Contractor shall carry out all works described in these documents strictly in accordance with this Specification, relevant Standards and Codes of Practice and the requirements of the Local Authority.

Connect the foul drainage installation to the Local Authority Foul Sewer, at a point external to the site, as indicated on the site layout plan.

Connect the surface water drainage installation to discharge into the drainage system, if it exists, at a point external to the site, as indicated on the site layout plan.

Co-ordinate the works with the Local Authority in accordance with the building programme and ensure the least inconvenience to the site or surrounding areas.

Strictly adhere to the materials described within this Specification.

Do not commence the drainage works until all materials are delivered to site.

Drainage Termination (Internal)

The underground drainage installation shall in general terminate at Lowest Floor Slab Level.

Where drainage pipe work is indicated as passing through a structural retaining wall connecting to a suspended pipe work installation include the suspended pipe work to form part of the drainage works and terminate at the Floor Slab level immediately above the point of entry through the retaining wall.

Drainage Termination (External)

The drainage installation shall terminate at and include the connections to the Local Authority Sewer.

Drainage By-Laws and Regulations

The Contractor shall state which standards are to be used and submit a copy of the relevant International Standards to the Architect/ Engineer or his appointed representative at the commencement of the contract.

Notification for Inspection

Give a minimum of 24 hours' written notice to the Architect/Engineer or his appointed representative for the purpose of inspection and measurement whenever sections of:-

a) Setting out is completed;
b) Excavations are completed;
c) Concrete and/or granular beds are laid;
d) Drainage installed ready for testing;
e) Compaction/Backfill is to be carried out;
f) Sewer connections are complete;
g) Final testing/commissioning;
h) Simultaneous discharge test.

No further work shall be carried out until each stage of the work has been inspected approved and signed off.

Existing Drain/Sewers/Manholes

Check invert levels of all existing drains, sewers, or manholes before laying new drains, notify the Architect/Engineer or his appointed representative if the declared invert levels are found to be inaccurate.

Where it is necessary to cut into any live drain within the boundary of the site carry out the works causing the minimum disruption to the existing drainage system while the connection is being made.

Check existing drains crossing the area of the site operations, ensure they do not serve other buildings outside the site boundary and either remove and plug off at manholes, or divert clear of the works as directed by the Architect/Engineer or his appointed representative.

Check all drains to be abandoned and record the locations on drawings before filling is carried out.

The Contractor shall indemnify the Employer against all risks connected with any existing pipe mains, drains, sewers and the safety thereof and for all damage caused to them through, or in consequence of, site operations during the construction of the works.

Local Water Authority Sewers

Obtain written consent from the Local Authority before cutting into any Public Sewer.

Confirm to the Local Authority the requirements for the sewer connections, giving size, line, level, and location and establish a programme for the work to be carried out, make necessary arrangements for traffic diversions, road closure order, and any other requirements to comply with the programme.

Drainage, Water, Electric, Telephone Supply Authorities

Give information regarding the line and level of these services and co-operate with the Local Authority, Water, Electricity and Telecommunications Authorities, or any other authorized firms to enable them to provide and lay mains, cables, sewer connections etc., along routes on or adjacent to the site without any undue delays or interruption.

No claim will be allowed for any delay or interference which may be occasioned by this work.

Ensure the various authorities or companies lay their mains in the given positions and/or make provision to enable them to do so at a later date without disturbing the structure of carriageways and/or paved areas, supply drawings showing the runs and positions of such mains to be included as part of the contract.

Ensure supply authorities, companies and/or their agents properly consolidate and reinstate all trenches and other excavations opened by them to ensure the safety of the persons passing adjacent to or within the area of site operations.

On-Site Drainage, Sewers /Water Mains, Electric/Telephone Cables etc.

Take all precautions to avoid damage to water, drains, sewers, culverts, telegraph, telephone or electric cables, ducts or other apparatus that may be met in the course of excavation, together with any walls, buildings or other properties adjacent to the area of operations. Maintain and protect during the progress of the works.

When any water mains, drains, cables etc., are encountered, inform the Architect/Engineer or his appointed representative and obtain information as to the necessary supports or protective measures which may be necessary in accordance with the requirements of the respective Authority or Company, including approval to any permanent works that may have to be put in hand for the purpose of support, protection or deviation.

The cost of providing temporary supports, protection of pipes, drain cables, etc., shall be included and measured as part of the Contract.

If the Architect/Engineer or his appointed representative on inspection of any existing pipes, drains, cables etc., considers that they are in a condition requiring repair, renewal, deviation or other work to maintain their efficiency, and such work not being considered due to any damage caused by site operations, he shall request remedial works be carried out to make good any such damage.

Invert Levels

Invert levels are generally given at all main points of intersection and changes of direction determine all intermediate levels as required by calculating the gradients between given invert levels.

Setting Out

Where the drainage works are to connect directly to a soil, waste or rainwater system the Contractor shall be responsible for:-

(a) Checking all dimensions with his Plumbing Sub-contractor to ensure that all connections relate accurately to his "Sanitary Pipe work Installation Drawings";

(b) Ensuring all dimensions relate correctly to the site setting out and building dimensions shown on the latest Architect/Structural Engineers drawings; and

(c) Relating to the specified sanitary fittings dimensions shown on the Architects Sanitary Fitting Schedule.

Report any uncertainty as to the accuracy of the dimensions or tolerances before the works are carried out, check the drawings and all associated details in sufficient time to enable any adjustments to be made and necessary instructions to be issued. Unless sufficient time is given no claim for delay will be considered.

2. MATERIALS

General

Provide all pipe work, fittings and materials to the entire satisfaction of the Architect/Engineer or his appointed representative in accordance with British Standard Specification or equivalent International Standard.

Standards

EN1401 UPVC Pipes & Fittings for below ground gravity drainage & sewerage.

OR APPROVED EQUAL to European norm i.e. Din, NF, American Standards …Etc.

All materials or article required to comply with a shall incorporate the stamp of the registered certification "kite mark" of the Standard Institution, or alternatively, copies of test certificates shall be furnished by the suppliers or manufacturer indicating compliance with the relevant Standard.

Manhole/Inspection Covers and Frames

Covers and frames shall be either solid or recessed top as described and conform to the following requirements:-

Grade B - Medium Ductile Iron covers and frames shall withstand a test load of 250kN used in areas subject to a wheel load of up to 5.00 tones with non-rocking covers and/or machined faces.

Pre-Cast Concrete Manholes

Shall conform to BS.5911, or equivalent be "Kite Marked" and consist of concrete aggregate chamber rings incorporating "Ogee" joints. Manholes exceeding 1.800m. in depth shall have either a reinforced concrete reducing slab, or a straight back taper with pre-cast concrete shaft rings.

The rings shall have rebate joint for watertight construction.

Provide a pre-cast reinforced concrete cover slab with clear opening to suit the specified manhole cover.

The opening in the concrete cover slab shall be set over galvanized step irons cast into the concrete manhole rings by the manufacturer.

The chamber rings shall be set on an "in situ" concrete base slab incorporating the main drainage channel, and branch drain connections.

3. WORKMANSHIP

Setting Out

Before laying new drains check existing datum reference points, invert levels, and positions of existing drains, sewers, inspection chambers and manholes with the levels indicated on the Contract Drawings, and relate to building foundations, piles or other features to which the works are related.

The checking of any setting-out, line or level by the Architect/ Engineering of his appointed representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.

Connections to Sewers

Make arrangements to connect new drains to existing sewers to the satisfaction of the Local Authority.

Excavation

Carry out all excavation work arranging to visit site and to judge the extent of works, and site/ground conditions, check information on site reports, trial pits, borehole reports and establish ground conditions and strata.

Main excavation of drain trenches on any section of the works shall not be commenced until a full supply of pipes, fittings and materials is available for completing that section.

Clear the working area of all vegetation, rubbish, debris, contaminated earth, concrete, tarmacadam etc., and include for excavation in whatever type of soil is encountered.

Where top soil is to be replaced over backfilled trenches allow for removal and place clear of the main excavated material. Replace in a single layer at completion of the backfill operation and leave proud to allow for settlement.

Carry out in open cut all excavations to the lines and levels having a minimum size to permit accurate setting out, and installation of the works, including trench sheeting, efficient refilling of voids with approved material, all placed and compacted in accordance with this specification.

Formation of Excavations

Excavate immediately before laying bedding or pipe work.

Remove mud, rock projections, bolders and hard spot. Replace where necessary with approved filling material well consolidated, local soft spots to be stabilized by tamping in bedding material.

Excavations taken out to a greater depth than necessary shall be filled to the required levels with concrete or granular bedding material as directed by the Architect/Engineer or his appointed representative. The cost of additional fill material shall be deemed to be included in the rates of excavation.

The bottoms of all excavations, trenches and headings shall be inspected and approved by the Architect/Engineer or his appointed representative before any concrete or granular bedding is deposited or pipes laid.

Where a true trench formation is required and this cannot be achieved by excavation, a true trench formation shall be achieved using filled bagging or alternatively filled concrete blocks to give a trench profile as described in the Excavation clauses of this specification.

Transport of Spoil

Vehicles and containers used to transport excavated materials from site shall be constructed and loaded to avoid spillage, level all loads before commencement of journey.

Any spillage that occurs outside the boundary of the site shall be cleaned away at the end of each working day.

Laying Drainage Pipe work - General

All pipe materials including concrete, granular material for bedding and surround to be in accordance with the Materials Specification of this document. All pipes, fittings and associated materials to be installed strictly in accordance with the manufacturer's recommendations and technical installation manuals.

Check all pipes and fittings, and test for soundness. Do not use damaged pipe work or fittings in the work.

Cut all pipes square and clean, using approved pipe cutting apparatus or chain cutters.

Manholes/Inspection Chambers General

Construct all main drainage lines, channels, step irons, benching and branch connections in the specified pipe work and materials with all branch connections discharging in the direction of flow.

Set the concrete cover slab to suit the completion of the surround levels, adjust as necessary, and make allowance for the thickness of the cover and frame and the required courses of engineering bricks for level adjustment.

The depth of the main open channel shall not be less than half the diameter of the main drain line unless otherwise indicated on the Contract Drawings, use vitrified clay channels on pipes up to and including 300mm diameter and joint in sand/cement mortar 1:2.

Where level invert channels and branch connections are required use level invert branch vitrified clay channels or form in situ granolithic concrete 1:1 trowelled to formation and smooth finish.

On branch channel bends up to an included 150mm diameter install three quarter section curved bends in the direction of flow set to discharge over the main channel invert joint in sand/cement mortar 1:2 and form benching.

On branch channel bends over 150mm diameter form in in situ concrete as part of the benching and finish in 25mm thickness granolithic concrete 1:1 trowelled smooth and curved in the direction of flow.

When installing the main drainage line the channels or chambers within the manholes/inspection chambers must be installed at the same time to give continuity of line and to ensure the correct setting of branch connections.

Build galvanized step iron into manhole/inspection chamber walls as work proceeds at 300mm horizontal and 300mm vertical centres directly above the benching as shown on the Contract Drawings, carried up to and within 225mm of the cover and channel benching.

Fix covers and frames in position, bed all frames in sand/cement mortar 1:3 maintaining cover level with surrounding areas, providing an angled fillet to hold frame square to the brick base where covers are located in temporary positions held secure with angled filled and rest to suit final finishes.

Keep all covers in their respective frames at all times to prevent rocking and deformation of frame.

Set light duty frames with covers in position to prevent distortion of the frame.

Fill recessed pattern covers with suitable material to match surrounding areas, the infill material to be well consolidated and tampered, all finished truly level with smooth trowelled finish to paved areas, smooth recessed for filed finish, and tampered finish to rough textured surface.

Pre-Cast Concrete Manhole Construction

Refer to "Manholes/Inspection Chambers General" for description of all associated works.

Construct the pre-cast concrete rings on an "in situ" reinforced concrete base slab to the thickness and profile shown on the Contract Drawings.

Place the rings in position on the base slab set over the main drainage pipeline, channels, branch connections, etc., all set truly level and vertical.

Construct the "in situ" concrete base up to a level of 150mm above the crown of the main drainage line to the profile shown on the Contract Drawings, and form a level base to receive the manhole rings.

Set pre-cast concrete manhole rings on a sand/cement mortar bed 1:2 on the concrete base all set level and firm for placing additional rings.

Ensure all joints are liberally provided with sand/cement mortar 1:2 before lowering sections into position, and neatly strike off joints on the inside of the chamber, filling any voids as work proceeds. Make good any lifting holes.

Make all watertight construction joints in accordance with manufacturer's recommendations and technical installation manuals. Neatly strike off joints on the inside of the chamber, filling any voids as work proceeds, and make good any lifting holes.

When placing pre-cast concrete manhole rings ensure the step irons are aligned vertically and at 300mm horizontal pitch, set over the benching, and in line with any access shafts, pre-cast concrete cover slabs and manhole cover.

Where pre-cast concrete manhole rings are to be supplied without step irons, build in a galvanized mild steel access ladder in the location indicated on the Contract Drawings, complete with all bolt fixings.

When all pre-cast concrete manhole rings, access shafts, cover slabs etc. have been set in position, using sectional fiber glass manhole shuttering, completely surround the manhole rings in 150mm in situ concrete well compacted.

Set pre-cast concrete cover slab in position with the opening in line with the step irons laid on a sand/cement mortar 1:2 bed, all set truly level, filling any voids in the bedding and flush point on the inside of the manhole wall as work proceeds.

Allow concrete work to set hard before back-filling the voids between the concrete surround and side of the excavation.

Concrete Block Manhole Construction

Refer to Manholes/Inspection Chamber General for description of all associated works.

Construct manholes in concrete blocks on an in situ reinforced concrete base with blocks set in bond with no straight joints using sand/cement mortar 1:3, building in galvanized step irons as work proceeds.

Fill hollow blocks with concrete and compact well before construction.

Completely fill all beds and vertical joints with mortar, and cut and flush point as work proceeds.

Backfilling General

Backfilling to trenches shall not be carried out until all interim tests have been successfully concluded.

Backfill adjacent to foundation in accordance with the details shown on the Contract Drawings.

Do not fill void between side of excavation and pre-cast concrete manhole walls until seven days after concrete has been poured and set hard.

Where excavated material is unsuitable for backfilling, suitable material shall be imported to comply with the requirements of this specification and the Engineer's requirements.

4. TESTING

Testing & Inspection

Test all drainage works to obtain the approval of the Local Authority, Architect/Engineer or his appointed representative and generally the following requirements.

Give a minimum of 24 hours' notice to the Architect/Engineer or his appointed representative when interim and final tests are to be carried out to give him/her the opportunity to observe tests.
Keep a record of all tests duly signed, and hand a copy to the Architect/Engineer or his appointed representative for retention.

Any works having previously passed any tests will not relieve the Contractor of his obligations when any further defects are shown during final tests, or appear during the maintenance period. Any defects shall be located and rectified, and the system retested in accordance with this section of the specification and as directed by the Architect/Engineer or his appointed representative.

Ensure all sections of the drainage system are completely clear of obstructions, builder's debris, silt, etc. before interim and final tests are carried out on each section of the installation, all drains to be cored through using apparatus to suit the diameter of the pipe.

Provide all facilities, equipment, clean water, appliances and materials for interim and final testing, and arrange to place in position any branch connections, tubes and plugs when and where required. Seal off and remove all equipment during and after tests.

Testing Underground Manholes/Chambers

Test all chambers for water tightness. Keeping external faces clear of backfill for inspection until approved, temporary seal all pipe connections within the chamber and fill with water up to 1.500m above the crown of the pipe allowing time for absorption. Allow adding water before starting the test, and maintain water level for 30 minutes without adding further water. Any manhole/chamber failing the test shall be re-constructed until a satisfactory test result can be achieved.

Record Drawings

The Contractor shall keep a record of any changes to pipe work location or adjustments to levels during the course of the contract and prepare upon completion Record Drawings/Schedules equal to the Contract Drawings.

The Contractor shall keep a record of any changes to pipe work location or adjustments to levels during the course of the contract, and upon completion hand to the Architect/Engineer to enable him to prepare record drawings.

Handover

Thoroughly clean and flush out the entire drainage installation and clean out silt and debris from drainage gullies etc. before handover.

Give a minimum of 24 hours' notice when tests are to be carried out and provide sufficient personnel to carry out the flushing operation of the various appliances.

Hand to the Architect/Engineer or his appointed representative, copies of the "As Fitted" drainage record drawings.

CHAPTER THREE

SANITARY, WASTE & RAINWATER PIPEWORK INSTALLATION

3.0 SANITARY, WASTE AND RAINWATER PIPEWORK INSTALLATION

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CHAPTER THREE

SANITARY, WASTE AND RAINWATER PIPEWORK INSTALLATION

1. GENERAL PREAMBLE

Scope of Work

Soil, Waste, Vent and Rainwater Installations.

Waste Installations.

All Overflows Pipes.

Sanitary Fittings

Shall include the following:-

Order, take delivery, store, and protect during the course of the contract all sanitary ware including fixtures and fittings all in accordance with the sanitary fitting specification and standard.

Allow for fixing and protecting all sanitary ware, fixtures and fittings as indicated, all strictly in accordance with the manufacturers' recommendations.

All pipework and fittings used in the hot and cold water service installations shall be as specified herein.

Allow for all overflows and warning pipes where indicated on the drawings using pipework and fittings specified herein.

2. MATERIALS

General

All pipework, fixtures and fittings shall comply strictly in accordance with the relevant International Standard Specification.

Standards

Where a British Standard and/or Code of Practice is quoted in this Specification, refer to the latest published standard and any subsequent amendments.

British Standard Institution documents referred to in this Specification are:-

BS.4514 Unplasticized PVC soil and ventilating pipe, fittings and accessories or approved equal EN.

BS.5254 Polypropylene waste pipes and fittings (external diameter 34.6 mm, 41.0 mm and 54.1 mm) or approved equal EN.

BS.5255 Plastics waste pipe and fittings or approved equal EN.

BS.3943 Plastics waste traps or approved equal EN.

BS.2494 Materials for elastomeric joint rings for pipework and pipelines or approved equal EN.

British Standard Code of Practice referred to in this Specification are:-

BS.CP.5572 Sanitary Pipework or approved equal EN.

BS.6367 Drainage of Roofs and Paved Areas or approved equal EN.

Building Standards and Regulations

All pipework and fittings shall be installed strictly in accordance with Local Authority Regulations or equivalent.

Termination

The installation shall be deemed to terminate at the buried drain connections.

3. PIPEWORK MATERIALS

Main Soil Waste and Rain Water

Pipe Size	Material
110mm, 160mm 200mm 300mm	- UPVC (EN – 1401)

Main Soil, Waste Rain Water and Vent Pipework shall be deemed to include horizontal pipework underground drainage.

Branch Soil, Waste and Vent Pipes

Pipe Size	Material
- 50mm	- UPVC (DIN. 19531)
- 82mm 110mm 160mm 200mm	- UPVC(BS.4514)+(EN.1329)

Branch Soil, Waste and Vent Pipework shall be deemed to include for all vertical and/or horizontal pipework between the connection to drain or main soil, waste and vent stack, and the terminal connections to the Sanitary appliance or fitting.

All soil and waste pipe work discharging from sump pits shall be cast iron.

Rainwater Pipes

Material	Pipe Size
UPVC (BS.4514) + (EN.1329)	φ 80 - φ 110 - φ 200

General Requirement

There shall be no deviation from the details indicated on the drawings, any alterations to the design intent without prior approval shall be restored to the original design at no extra cost to the contract unless it is proven that the original design cannot be accommodated.

The entire installation shall be carried out to the satisfaction of the Architect/Engineer or his appointed representative.

4. PIPEWORK INSTALLATION

General

All pipework shall be installed truly vertical or if horizontal to the gradient dictated by the design.

All bends and offsets shall be kept to the minimum number and if required be of a wide sweep pattern.

All pipework shall be cut clean and square with the axis of the pipe with all sharp edges and/or burrs removed before installation.

Should any blockage occur within the system caused by general negligence or abuse pipework shall be removed and the system thoroughly cleaned out at no extra cost to the contract.

Pipework Fixtures and Fittings

All pipework fixtures and fittings shall be installed using the correct fixtures and fixing procedures including support brackets to suit the specified materials, and hold pipework secure.

All bracket and support fixings shall be in accordance with the details shown on the coded detail drawings.

UPVC Pipework and Fittings

Shall comply to British Standard 4514 bear the British Standard Kite Mark, or equivalent and shall be installed strictly in accordance with manufacturers recommendations.

All pipework shall be supplied in plain ended lengths.

The pipe and fittings shall be to colour grey, British Standard 5252 with the exception of water closet connections which shall be coloured white where exposed to view.

Method of jointing shall be a combination of solvent welding using the manufacturer's approved solvent cement, with seal ring fittings used where necessary to accommodate thermal movement. The sockets of standard fittings shall be converted to incorporate a rubber seal ring where required.

UPVC Pipework Installation

All pipework shall be installed to accommodate thermal movement, flexible joints shall be incorporated at all fixed points and changes of direction with a secure fixing bracket located in the retention groove moulded on the socket of the fitting.

Waste boss connections when fitted to the pipes shall consist of two parts with inner and outer flanges, solvent welded as a complete unit with inbuilt gradients of 1 1/4^{o}. Where it is not possible to gain access to the bore of the soil pipe self-locking bosses with integral clamping devices shall be used providing the mating surfaces are suitable for and used with solvent weld cement.

Access shall be provided to gain entry into all pipework either by means of an integrally moulded door in an access fitting with external fitted rubber seal and secured with two galvanised bolts and nuts, or alternatively a two piece clamp type door fitted into the pipe run.

Where WC connections are to be fixed in a range a single manifold branch shall be used comprising a single branch with a standard WC connector welded together, up to six WCs may be connected on either side of the soil stack using the available left or right hand fittings as required.

The correct angle and type of fitting to suit the application shall be as described in the manufacturers Product Handbook.

The system shall be installed strictly in accordance with the Product Handbook complying with the recommendations of BS.4940.

UPVC Pipe Supports

UPVC pipe supports shall be made of mild steel with galvanised or PVC protective coating, supplied to suit the specified pipework and fittings and have a two position fixing suitable for either acting as a pipe support allowing thermal movement, or alternatively as a clamp fit on a fitting creating a fixed point. For optimum fit on pipe supports UPVC spacing pieces shall be used.

Maximum intervals between pipe supports shall be:-

Pipe Size	38 mm	42 mm	50 mm	75 mm	100mm
Horizontal	0.5 m	0.5 m	0.6 m	0.9 m	0.9m
Vertical	1.2 m	1.2 m	1.2 m	1.8 m	1.8m

Pipework shall be fixed truly vertical with all horizontal runs laid to gradients in accordance with British Standard 5572 and in any event not less than 18mm/m unless otherwise instructed.

The pipework shall be fixed to the fabric of the building in accordance with BS CP 5572.

5. WASTE INSTALLATION

Access Fittings

All fittings shall give full width access into the bore of the pipe and located as indicated on the drawings.

Access Location (General)

Access points shall be provided to give full access to all sections of installation at the locations indicated on the drawings, to enable section testing and efficient maintenance operations to be carried out and to enable every section of Soil, Waste or Rainwater Pipework to be rodded, tested, inspected and to enable the easy removable of objects or debris from the system.

Roof Vent Fittings

All vent pipes passing through the roof shall be fitted with a connector suitable for a weatherproof seal and to ensure a completely watertight arrangement.

The pipe shall terminate 450mm above finished roof level with a section of spigot end and vent cage, complete with a weathering shroud to enclose the waterproof finish.

WC's Connectors

Pipework connections to WC's shall be flexible self-sealing connectors incorporating multiple plastic and rubber seal gaskets. The connector shall incorporate outward facing rubber seals and plastic fins for insertion into the pipe, and an internal rubber seal with plastic shroud for connection to the WC pan.

The Connectors shall suit the specified pipe materials.

Storage of Pipework and Fixtures and Fittings

All pipework fixtures and fittings including jointing materials shall be stored within a clean dry storage area protected from extreme temperatures and where applicable in accordance with manufacturers recommendations.

UPVC

All pipework fittings, gaskets, and solvents shall be stored to avoid direct exposure to sunlight, and extreme temperature conditions.

Pipework shall be stored on level ground free from stones or sharp objects either on timber bearers 75mm wide and not greater than 1 metre centres and stacked neatly not more than 1 metre high, or alternatively stored in loose racks with side support not greater than 1.5 metres apart.

All fittings, gaskets and solvents shall be stored within a well ventilated cool compartment, and retain in plastic bags and storage containers until ready for installation.

Pipe Sleeves

Where pipes pass through walls, or floors tubular pipe sleeves of non-combustible material shall be provided of sufficient size to permit the free passage of the pipe through the sleeve to ensure the pipe neither touches the sleeve nor the building structure.

All pipe sleeves shall be set in the walls, or floors before plastering or screeding is completed.

All sleeves shall be suitable for the pipe on which they are to be fitted and shall extend the full thickness of the division through which the pipe is to pass, after installation the gap between pipe and sleeve shall be "fire stopped" with suitable non-combustible caulking compound.

Where UPVC pipework passes through walls or floors a fire sleeve shall be provided tested in accordance with BS.476 comprising of a metal clad flanged sleeve with fire resistant filler rings in accordance with the detailed drawings.

Rainwater Roof Outlets (Roof Drain)

All rainwater outlets shall have a flashing clamp, luting flange, stone guard with dome grating as required with outlet connection suitable for the specified pipe material and designed to fit into the roof structure.

RD-01: Roof Drain – Dome Type, Side Outlet

Floor Gullies (Floor Drain)

Floor gullies and channel gratings shall be supplied and installed as required within public bathrooms and toilet areas. Where these are of a quality finish they shall be suitably protected until completion of the contract.

Where traps are suspended they shall have weight support lugs cast on with suitable bracket fixing back to the structure.

FCO : Floor clean out – 20 cm x 20 cm Nickel Bronze Cover, Ø 110mm Bottom Outlet
FD-01 : Floor drain – 20 cm x 20 cm Nickel Bronze Cover, Ø 75mm Bottom Outlet
GFD-01 : Grating Floor Drain – 20cm x 20cm Light Duty Steel Cover, Side Outlet.

Waste Connections to Mechanical Services Plant

Waste and/or overflow connections from, pump glands, etc, shall discharge into a tundish and connect to drain via a trap connection or alternatively discharge over a trapped floor gully, but on no account connect to a soil pipe.

Overflows/Warning Pipes and Sanitary Fittings

All overflows and/or warning pipes shall be installed strictly in accordance with the Water Authority Bylaws/Regulations including any subsequent amendments, and the detailed drawings.

Depending on the location, the overflows and/or warning pipes shall discharge in the following locations and as indicated on the drawings.

a) External to the building
b) Over a Sanitary Fitting
c) Over the floor

Testing, Flushing Out and Cleaning of Soil, Waste, Vent and Rainwater Pipes

All pipework to be concealed shall be tested before being enclosed, a final test shall be made upon completion for soundness and performance strictly in accordance with the British Standard 5572, and include a simultaneous discharge test.

At completion of the installation all plugs shall be removed and the entire system flushed and rodded through.

6. APPROVED MANUFACTURERS

UPVC
a. Redi
b. Nicoll

or approved equal.

FB & JB
a. Zurn
b. Wade
c. Josam

or approved equal.

CHAPTER FOUR
PIPED SYSTEMS (LIQUIDS)

4.0 PIPED SYSTEMS (LIQUIDS)

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CHAPTER FOUR
PIPED SYSTEMS (LIQUIDS)

1. GENERAL

This section of the Specification shall apply to the following pipework installations:-

Domestic Cold Water.
Domestic Hot Water.

Demarcations

The Domestic Cold/Hot water service installation shall include final connections between isolation stop-cocks or valves serving sanitary appliances or equipment and the appliances/equipment being served.

2. PIPEWORK INSTALLATION (GENERAL)

Gradients and Erection of Pipework

Pipework shall be graded to ensure adequate draining and venting and wherever possible be self-venting. Draining and venting facilities as detailed in this Specification shall be fitted at all low and high points respectively and wherever else necessary to ensure that all sections and subsidiary sections can be drained and no air locks can form.

The gradients shall be in the direction of flow and shall be appropriate to the service as follows unless otherwise stated on the drawings:-

Service	Gradient
All services	1 in 250

Pipework shall generally be set around all pipes and columns and shall follow the contours of the building whether so indicated or not.

Bare piping shall be erected so that there is 75 mm clear below it to the finished floor level and at least 25 mm to the finished wall face.

Insulated piping shall have sufficient clearance for the proper application of the insulating material. The finished surface of any covering shall be at least 25 mm from walls etc. Clearance between adjacent insulated pipes shall be at least 25 mm.

All pipework valves, fittings and equipment forming the piping installation shall be erected so that it can be dismantled and is accessible for repair and replacement.

Pipe and Services Supports

All pipework shall be supported by means of clips, hangers etc., or in the manner and positions indicated at intervals not exceeding the following:-

Care should be taken with the design and installation of supports for A.B.S., pipework, which shall be designed in accordance with the manufacturer's recommendations but shall not be greater spacings than the following table:-

Pipework O/D	PPR Maximum Horizontal Support Distance m
20mm to 50mm	1.1

In the event of two or more pipes being carried by a single support the spacing shall be for the short intervals. No more than two pipes may be supported from a single drop rod support. Double hanging of pipes with unequal expansion movement due to different service temperatures shall not be permitted.

Metal pipe clips on plastic pipework shall be free of sharp edges likely to damage the pipe.

Valve supports shall be provided for all large diameter valves in plastic pipework to ensure that distortion of the pipework does not occur.

It shall be the responsibility of the Contractor to ensure that all supports are adequate, firmly and truly fixed, and that they do not transmit vibration.

The Contractor shall provide and install all fixings to the structure or cast in support channels where appropriate to carry the brackets, clips, hangers, etc., for the various services.

The Contractor shall provide all necessary steelwork for the support of the Services in vertical risers at the required intervals, which shall be detailed on drawings and submitted for approval. The drawing shall show full details of all steelwork sizes and fixings and shall show the imposed load from each service.

All pipework shall be supported by substantial brackets, hangers, or clips to the approval of the Engineer. The layout of piping shall take into account expansion and contraction, particularly at ends of runs where changes of direction occur. Main walls or partition walls etc., where pipes pass through sleeves shall not be considered as pipe supports.

Supports for insulated pipes on cold-water service shall be arranged so that there is no penetration by metal of the pipe insulation. In addition precautions must be taken to preserve an unfractured vapour-proof skin at these joints. Two half sections of high density phenolic foam (120 kg/m^3) to fit the pipes and of correct thickness to suit the insulation shall be used at all support positions. The joints between the high-density phenolic foam and the insulation shall be chamfered and trowelled in with a mastic compound.

In exposed areas and where metalclad pipework insulation finish is provided the vapour barrier shall be over the band clip to ensure a concealed and straight line finish appearance.

When rested upon fixed supports, freedom of longitudinal movement must be provided.

Pipe Sleeves and Puddle Sleeves

Where pipes pass through walls, floors, footings and waterproof membranes, the Contractor shall include in his price pipe sleeves.

The inside diameter of sleeves shall not be less than 15 mm larger than the outside diameter of the pipe except where pipes pass through bearing walls or footings where sleeves shall be sized to allow for structural movement and 15 mm clearance from the outside diameter of the pipe.

The diameter of the sleeves for cold-water pipework shall be such that adequate clearance between the pipe and the sleeve will enable the insulation to be carried through the sleeve.

Sleeves shall protrude not less than 2 mm and not more than 4 mm proud of the finished surface.

Flushing of Pipework Systems

Prior to the chemical cleaning or treatment of any pipework system the entire system, sectionally or as whole, shall be subjected to a full bore rapid flush to ensure the complete removal of any loose foreign material. This shall also apply to pipework systems where chemical cleaning is not called for.

The Contractor shall also be responsible for providing temporary fill and drain points on each system and for making whatever temporary arrangements that may be necessary to have adequate raw water available at the fill points and for the removal of flushing water from the drain points.

Approved Manufacturers

Galvanized Steel Supports for Pipes
a. Flamco
b. Walraven
c. Mupro
d. Erico

or approved equal.

3. PIPEWORK SERVICE MATERIALS

Polypropylene (PPR) Pipes and Fittings

A. Polypropylene pipe shall conform to the following requirements:

- Polypropylene pipes shall be made of polypropylene, a copolymer RANDOM, Beta PPR with enhanced crystalline structure, Class-2 (S-3.2; SDR-7.4) for embedded domestic cold and hot water pipes applications. Beta PPR with Aluminum layer for exposed and embedded heating pipes, and for exposed cold and hot water pipes application conforming to EN ISO 15874 or approved equal International Standards (DIN, ASTM, ….) for polypropylene pipes.

- Polypropylene pipe: ASTM F 2389, pipe pressure rating shall comply with temperature and pressure ratings per the plumbing code requirement for the applicable service (water distribution, water service).

- Fittings shall have same material and quality as pipes and according to EN ISO 15874.

- Polypropylene Fittings: ASTM F 2389, socket fusion, butt fusion, electrofusion, or fusion outlet fittings shall be used for fusion weld joints between pipe and fittings.

- Mechanical Fittings and transition fittings shall be used where transitions are made to other piping materials or to valves and appurtenances.

- Polypropylene pipe shall not be threaded. Threaded transition fittings per ASTM F 2389 shall be used where a threaded connection is required.

B. Polypropylene – Random Copolymer

- Polypropylene – Random Copolymer (PP-R) used for the manufacture of pipes shall confirm to the requirements of IS 10951 and IS 10910.

- The specified base density shall be between 900 Kg/m^3 and 910 Kg/m^3 (both inclusive) when determined at 27°C according to procedure prescribed in IS 13360 (Part 3/Sec 1).

- The MFR of the material shall be ≤0.5 g/10min when tested at 230°C with nominal load of 2.16 Kg as determined by method prescribed in IS 13360 (Part 4/Sec1). The MFR of the material shall also be within ± 20percent of the value declared by the manufacturer.

- The resin shall be mixed with sufficient quantity of colour master batches. The colour master batch description shall be uniform throughout the pipe surface.

- Outer Layer (Optional)

  The base resin used for outer layer compounds shall be a base resin certified by the supplier to be compatible to the PPR resin/master batch that is used to produce the pipes.

  Coloured outer layer compound shall be UV stabilized with minimum of 0.2 percent of a hindered amine light stabilizer (HALS).

- Anti-oxidant

  The percentage of anti-oxidant used shall not be more than 0.3 percent by mass of finished resin. The anti-oxidant used shall be physiologically harmless and shall be selected from the list given in IS 10909.

C. Multilayer PPR Pipes and Fittings with Aluminum

- Aluminum System includes multilayer pipes in PPR-AI-PPR and it consists of PPR pipes that meet the diameters of the metric series, covered by an aluminum alloy layer and an external layer of black PPR, the three layers are joined by a special polymer acting as adhesive. Before welding, it is necessary to remove the aluminum layer using the appropriate pipe-skinner.

- Aluminum System is a perfect combination of metal and plastic pipe since it grants the advantages of both types eliminating all the disadvantages.

  The presence of the aluminum layer creates an oxygen barrier protecting the internal PPR layer from oxidation avoiding the bacterial and alga proliferation inside the pipes; moreover it reduces the thermal expansion of more than 80% making installation easier thanks to the reduced quantity of fixed and sliding points.

Finally the external layer in black PPR grants a further barrier against UV rays and a higher resistance to ageing allowing installation of Aluminum pipes outdoor.

D. Multilayer PPR Pipes and Fittings with Fiber Glass

Faser-composite PPR pipes reinforced by an intermediate layer of special glass fibers that adds to the advantages and features already exposed for the PPR pipes those of the intermediate layer. The pipe is produced by coextrusion: the three layers are processed and extruded at the same time, in this way the pipe results perfectly homogeneous and uniform, ensuring high performances.

Some advantages compared with monolayer pipes are:

- Thermal expansion reduced by 75%
- Reduced amount of fixing points
- Higher mechanical stability
- Increased flow rate
- Lower pressure losses

The low concentration of glass fibers does not influence fusion and recycling process, leaving unchanged installation and use.

Approved Manufacturers (PPR Pipes & Fittings)

a. API
b. Alfaidro
c. Vesbo
d. Uplast

or approved equal.

4. VALVES AND COCKS

General

All valves and cocks shall be generally as described and of first class quality.

All castings shall be clean close-grained metal free from rough projections. Unless otherwise specified valves of 50 mm nominal bore and under shall have female ends screwed to BS 21 and valves 65 mm nominal bore and over shall have flanged ends.

Screwed valves shall have heavy hexagon reinforcements at openings, threads of ample length and heavy shoulders to prevent over entry to pipes. Flanged valves shall have the flanges flat faced on valves 50 mm and below and raised face on valves 65 mm and above and of thickness conforming to the appropriate Specifications and drilled.

All valves must have the maker's name or trade mark cast or heavily stamped or rolled on. Valves not bearing these distinguishing marks will be rejected.

Each valve must be made easy to operate before being installed.

Regulating and isolating valves shall be fitted to permit proper isolation and regulation of plant and primary and secondary mains.

All mains shall be provided with isolation valves at the point of entry or exit.

All valves shall be suitable for the fluid carried and the temperatures, test and working pressures of the system in which they are installed.

Where flanged ends are specified, the flanges shall be of the type and nominal pressure rating as specified in the 'Flanged Pipework Jointing' clause in this Section of the Specification.

Isolating Valves to Cold and Hot Water Services

(i) General

Isolating valves shall be installed in the locations shown on the drawings and on connections to single groups of wash-hand basins or wc's, on the draw-off connections to individual sinks and on connections to equipment.

(ii) Mains Water Services

Isolating valves on pipework size 54 mm and below shall be stopcocks of the screw down pattern gunmetal construction in accordance with BS 1010 with pinned jumper and gunmetal or brass spindle with crutch head and union connection.

Alternatively isolating valves where used internally shall be full way lever operated quarter turn spherical ball valves manufactured from dezincification resistant bronze, polished balls and PTFE seats. Ends shall be compression to BS864 Part 2 and the valve shall be suitable for working pressure up to 16 bar.

Servicing valves up to and including 22mm to be the spherical plug type manufactured to BS6675 with compression ends to BS864 and shall be chromium plated.

Valves above 54 mm shall be cast iron, with inside screw, wedge gate valves manufactured in accordance with BS 5163 Class 2, having flanged ends and provided with wheel head assembly unless otherwise noted on the drawings.

Alternatively valves above 54mm shall be butterfly valves to BS5155, lever operation, suitable for pressures up to 16 bar. Valves shall be approved for use on potable water services.

(iii) Cold and Hot Water Services

Full way gate pattern valves 54 mm diameter and below shall be bronze or gunmetal construction in accordance with BS 5154 solid wedge disc, non-rising stem, and having either integral solder ring capillary ring union ends, or compression ring joints in accordance with BS 864 Part 2.

Alternatively isolating valves where used internally shall be full way lever operated quarter turn spherical ball valves manufactured from dezincification resistant bronze, polished balls and PTFE seats. Ends shall be compression to BS864 Part 2 and the valve shall be suitable for working pressure up to 16 bar.

(iv) Fitting Isolation Valves

Isolation valves to individual fittings shall be full port in-line spherical plug ball type of bronze or nickel construction, to BS 6675 with operating lever and compression ring joints in accordance with BS864 Part 2.

Ball Float Valves

Unless otherwise specified ball valves shall be of bronze or gunmetal construction manufactured in accordance with BS 1212, Part 1 and having a bronze or gunmetal seat, lever and plastic float conforming to BS 2456.

Where required ball valves of the delayed action type shall be provided generally as above and complete with hydraulic delay subsidiary tank and bottom float. Galvanised mild steel supports shall be provided to the valve manufacturers recommendations.

The ball valves shall be suitable for the particular pressure requirements at the point of discharge.

Drain Cocks and Drain Valves

Drain cocks shall be fitted on all low points and on the 'dead' side of all isolating valves and cocks.

Other than on HTHW drain cocks where in exposed positions in rooms shall be of the bronze draining tap type to BS 2879 Type A with screwed end and lockshield dustcap. Elsewhere they shall be of the bronze gland cock type with hose union.

Drain cocks where used on hot, cold and mains water services shall be of the pattern that can be readily rewashered and that are suitable for 1.5 times the system working pressure.

Safety Valves

Safety valves shall be of the enclosed spring loaded type complying with BS 6759 and of size not less than that required for the equipment specified. The safety valve shall be arranged vertically and attached directly to the equipment shell.

The safety valves shall have a padlock and key. Unless otherwise specified safety valve set pressure shall be:-

1.1 x working pressure

The setting shall not exceed the design pressure of the equipment.

Safety valves up to 50 mm n.b. shall have screwed connections, bronze body, cadmium plated steel spring with high tensile brass adjusting screw and locknut suitable for a maximum working pressure of 24 bar.

Approved Manufacturers

e. Crane
f. Nibco
g. Hattarsley
h. Serseg

or approved equal.

5. PIPEWORK ANCILLARIES

Flow Commissioning Sets

Flow Commissioning Sets shall be provided on all main, branch and sub-circuits throughout the heating and chilled water pipework installations to enable satisfactory commissioning of hydraulic circuits. The sets shall comprise a measuring orifice ring with pressure tappings, fitted complete with valve. This valve shall be a double regulating valve in accordance with the appropriate Service Specification, located in the return pipe.

Orifice ring fittings 50 mm and below shall have gunmetal body castings with screwed ends to BS 21 and comply with BS 1400. Orifice ring fittings 65 mm and above shall have cast iron flangeless bodies with notches for pipe alignment fitted with stainless steel orifice plates and gunmetal retaining bushes.

Pressure tappings shall be the brass body mechanical self-sealing type with screwed blanking caps.

For flow rates below 0.04 litres/s low flow or ultra low flow sets shall be provided, appropriate to the low flow rate condition.

Water Strainers

Strainers shall be located at inlets to control valve arrangements and pump sets and generally as detailed on the drawings.

The strainer shall be simplex or duplex as indicated on the drawings.

Each strainer shall be provided complete with a stainless steel strainer screen as follows:-

Application	Perforation Size mm
In pipework 15mm to 50mm nominal bore and on inlets to all control valves.	0.8
In pipework 65mm to 100mm nominal bore.	1.2
In pipework 125mm nominal bore and above.	1.6

Cold Water Applications:

Strainers up to 50 mm shall be "Y" type of bronze or gunmetal construction in accordance with BS 5154 screwed ends to BS 21.

Pressure Gauges

Pressure gauges shall be 100 mm and 150 mm diameter as specified, aluminium alloy cased with chromium bezel Bourdon Type BS 1780, Part 2 and shall be with plain glass front, concentric pointer and red line at the working pressure scaled in bars.

The range, unless otherwise stated shall be a maximum of one and a half times the working pressure. The tubes shall be of brass construction and removable, and the outlet screwed BSPT.

Temperature Gauges and Wells

Dial type temperature gauges with aluminium alloy cases black painted with chromium bezel shall be fitted in the positions as indicated. Each dial type gauge shall be of mercury in steel type having a nominal dial size of 150 mm.

All gauges shall have a white dial with black numbering and shall be calibrated to cover the operating temperature range plus 30°C on DHWS and cold water.

Water Meters

Water meters shall be provided on the incoming water main and shall be located within an accessible position so as to facilitate easy reading and maintenance.

Meters for use on pipework over 40 mm diameter shall be of the in-line Helical Vane type with graphite iron body to BS 2789 1973 420/12, polypropylene rotor, stainless steel bearings, and shall be provided with flanged connections to BS 4504.

Each meter shall be provided with a suitable pulsed output suitable for connection to a central control and monitoring system.

All counters shall read in cubic meters.

All meters in exposed positions shall be suitable for the prevailing temperature conditions without loss of performance or accuracy.

Air Release

Air vents shall be fitted at all high points. Pipework which requires venting shall be fitted with 6 mm air cocks on air bottles. Air bottles shall be formed from 150 mm length of tube of equal bore to the pipe which is being vented, with 6 mm pipe welded into the top and taken to a low level accessible position unless otherwise specified and fitted with 6 mm lockshield needle valve. The discharge from the needle valve shall be piped to a convenient position for discharge into a container.

In addition, vent points on oil lines shall be provided with a mild steel receptacle hooked onto the piping and arranged to collect oil drips.

Automatic Air Vents

Automatic air vents shall be installed in accessible positions and shall be of aluminium bronze construction with brass spindle nickel alloy valve and seat, brass float and integral lockshield isolating valve. In all cases the air vent shall be preceded by a lockshield pattern stop valve and the discharge from the air vent shall be 10 mm copper pipe. Automatic air vents shall be provided on each service, with the exception of HTHW and MTHW, at the highest point of the service within each plant area and on each vertical distribution riser.

Discharge pipes shall be collected over a covered tundish and the outlet piped to the nearest drain gully. Discharge pipes shall be labelled according to the service.

6. WATER STORAGE TANKS

Polyethylene Water Tank (s)

Polyethylene water tank(s) shall be of the size and shapes as indicated on the drawings.

All elements of the tank(s) and their appurtenances shall be designed to withstand all conditions of the intended service without undue stress or deflection. The design shall take into account the stressed caused by the contents of the tank. The minimum allowable thickness of any portion of the tank(s) and their appurtenances shall be 7 mm, which shall be increased as necessary to provide adequate strength and shall be fully insulated to minimize heat gain.

The tank(s) shall be provided with reinforced threaded openings for all pipe connections and float switches indicated on the Drawings.

The top of tank(s) shall be equipped with a removable cover. The cover shall have a whole cur for the fill.

Interior and exterior surfaces shall have a relatively smooth texture.

Approved Manufacturers (PE Tanks)

a. NTG
b. Somoplast
c. LG Tanks

or approved equal.

7. PUMPS

General

Supply and circulating pumps shall be provided and installed in the positions shown on the drawings and shall be of the type given in the Schedules of Equipment.

Each pump shall be driven by an electric motor complying with the relevant clauses of this Specification.

All exposed moving parts shall be guarded in accordance with the relevant clause of this Specification.

Flexible connections of pipeline size shall be provided on both the inlet and outlet of the pump. The pipework shall be arranged so that there is no undue strain on the pump or flexible connection. The flexible connection shall comply with the relevant clauses of this Specification.

As required elsewhere in this Specification each pump shall be provided with an identification plate.

Two copies of the pump test certificates and characteristic curves indicating the design operating point shall be supplied to the Engineer.

On packaged pump sets, the control panel shall comply with the latest edition of the I.E.E. Wiring Regulations and include protection from both direct and indirect contact by earthed equipotential bonding and earth leakage circuit breaker.

In-Line Pumps

In-Line pumps shall be constructed generally in accordance with the Specification for close coupled pumps with the exception that the suction and discharge connections shall be co-axial.

The pumps shall be glanded or glandless as scheduled.

Cold Water Booster Pumps

Pump sets shall be provided to meet the duties specified in the Schedules. The pump sets shall be self-contained fully automatic packaged units and arranged to operate as duty and automatic standby complete with control panels and accessories all assembled on a fabricated steel base with wiring and copper tube interconnecting pipework complete with bronze valves and reflux valves.

Interconnecting pipework shall incorporate lead-free jointing and be arranged such that the valves are removable without disturbing the header pipework or the pumps.

Valves shall be in accordance with the Local Water Authority requirements.

Pumps shall be vertical multi-stage quiet running high efficiency type with cast iron bodies, stainless steel shafts, bronze impellers and fitted with tungsten carbide faced mechanical seals. The number of pumps shall be as indicated in the Schedules.

The pump motors shall be totally enclosed, fan cooled type as described in the General Technical Requirements section of this Specification and fitted with anti-condensation heaters.

A hydraulic accumulator with rubber diaphragm set in a steel shell suitable for maximum unit working pressure shall be provided on pressure controlled pump sets.

A flow switch mounted in the pipeline discharge header and pre-wired into the control panel shall be provided. The control panel shall incorporate a bar heater together with controls for the heater and pumps.

The panel shall contain contactor, thermal overload relay unit for each motor, a set of fuses for each motor, a set of fuses for the control phase to neutral, Hand/Off/Auto switches for each pump, duty pump selector switch, indicating lamps, 'Power On' and 'Duty Pump Fail', main neutral link, alarm accept push button unit for duty pump failed circuits and any necessary pressure switches and adjustable settings for each pump.

The equipment shall be complete with all necessary terminals, labels, interconnections, wiring diagrams and spare fuses all enclosed in sheet steel dust and damp proof IP54 housing with lockable door. Low water alarm switches for each pump together with indicating lights in the control panel shall be provided with terminals for remote indication.

The inlet pressure for the pumps shall be from a flooded break tank having 1.5m maximum positive head.

Expansion Vessels

Expansion vessels shall be constructed of mild steel generally in accordance with BS 4814 and BS 5169 and as per ASME section VII Div. 1.

Each vessel shall be provided with a removable, heavy duty Butyl rubber bladder, removes easily for inspection and maintenance.

Each vessel shall be suitable for the working pressure of the system and shall be provided with a charging valve connections and feed connection to the system. The vessels shall be suitable for the total water content of the various systems.

Approved Manufacturers

a. Wilo
b. Lowara
c. KSB
d. ABS

or approved equal.

CHAPTER NINE
SANITARY FIXTURES

CHAPTER NINE
SANITARY FIXTURES

9.0 SANITARY, FIXTURES

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CHAPTER NINE
SANITARY FIXTURES

1. GENERAL

The Sanitary Fixtures Work shall consist of installing, testing and putting in operation all Sanitary Fixtures, accessoires, pipe fittings and equipment as here inafter specified and as show on the drawings.

2. GENERAL REQUIREMENTS

- All fixtures and trimmings, in sofar as practicable, shall be of one manufacture.
- Ample application of petroleum jelly shall be made to all surfaces of exposed chrome plated piping, valves and fittings immediately after installation
- All fixtures shall be set straight and true.
- Concealed brackets, hangers and plates shall have a shop coat of paint.
- All exposed piping and trim shall be chrome plated and fully protected during installation.
- Strap or padded wrenches shall be used on chrome plated pipefittings and valves.

3. SANITARY FIXTURES

- Sanitary fixtures shall be complete with all required trimming, including mixers (EN compliant), waste plugs or flow waste, traps, supplies, stop valves, escutcheons, casings and all necessary hangers, plates, brackets, anchors and supports.
- Vitreous china fixtures shall be of first quality with smooth glazed surfaces, free from warp, cracks, checks, discolorations or other imperfections.
- Enamelled cast iron fixtures shall be of acid - resisting type.
- The selection & approval of sanitary fixtures and their accessories & manufacturers is decided by the Client and or/his Representative

4. EXPOSED PIPING AND TRIM IN TOILET AREAS

All piping, valves and fittings exposed to view shall be screwed, polished, chrome plated brass. Plating shall be accomplished after threading.

5. FIXTURE SETTING

Fixtures shall be set in a neat, finished and uniform manner making the connections to all fixtures at right angles to the wall, unless otherwise directed by the Engineer. Roughing for this work must be accurately laid out so as to conform to finished wall material. Fixtures are not to be set until so directed by the Engineer.

The location and disposition of all items shall be as indicated on the relevant drawings.

All fixtures and fittings shall be as detailed in the schedule of fixtures, indicated on the drawings.

6. WATER CLOSET - Type EWC

White vitreous china, dual flush, water closet with wall outlet, syphonic action. EWC shall be complete with the following fittings:

WC pan with side outlet, cistern of 6 litres capacity for bottom supply and overflow with plastics syphon fitting, flush valve and mechanism, HP/LP bottom supply ballvalve with refill unit, ¾ in bottom overflow, servicing valve and close coupling fitment (cistern fittings are not reversible), and chrome plated side lever, seat and cover, screws (pair), Plastic outlet connector for connection to 102 bore soil pipe. System shall be completed with flushing hose.

EWC-01 Wall Hung: Minimum Dimensions of 50 x 40 cm

7. LAVATORY - Type LAV

White vitreous china lavatory shall be mounted basin into granite or marble vanity top and complete with the following fittings: 1 taphole ,mixer, 1 ¼ in bead waste, 1 ¼ in chrome bottle trap with 75mm seal concealed bracket with fixing clamps in aluminium alloy & servicing valve.

LAV-01 Semi-Pedestal Minimum Dimensions of 55 x 45 cm

08. BATHROOMS ACCESSORIES

Refer to Architecture BOQ and Specifications.

09. EXECUTION

Fixture Joints

Joints shall be standard fittings furnished with the fixtures. Where space conditions will not permit standard fittings, special short-radius fittings shall be provided.

The fixture joints on soil pipes shall be made absolutely gastight and watertight.

Strainers and Fixture Outlets

Lavatory basins shall have waste outlets not less 30mm in diameter. Wastes may have open strainers or may be provided with stoppers.

Shower-receptaclewaste outlets shall be not less than 50mm in diameter and have removable strainers.

Sinks shall be provided with waste outlets not less than 40mm in diameter. Waste outlets shall have open strainers or shall be provided with stoppers.

Fixture Supports

Wall hung plumbing fixtures not supported on chair carries shall be supported on wall hangers on screw bolts furnished with the fixtures.

Where appearance of the bolts is not objectionable, the fixture shall be fastened to the wall by through-joint bolts. Bolt heads or nuts shall be hexagonal and painted or chromium-plated, and washers shall be painted or chromium-plated to match bolt heads or nuts.

Where appearance of bolt heads or nuts is objectionable, fixture shall be fastened to walls by machine-bolt expansion shields or stud-type expansion bolts.

Fixture Traps

Sanitary fixtures, excepting those having integral traps, shall be separately trapped by a water-seal trap, placed as close to the fixture outlet as possible.

The trap shall be of the same diameter as the fixture drain to which it is connected.

The fixture trap shall have a uniform interior and smooth waterway.

Each fixture trap shall have a water seal of not less than 60mm.

Fixture trap, except those integral or in combination with fixtures in which the trap seal is readily accessible or except when a portion of the trap is readily removable for cleaning purposes, shall have accessible brass trap-screw of ample size.

Cleanouts on the seal of a trap shall be made tight with threaded element plug and approved washer.

No fixture shall be double trapped.

Approved Material for fixtures:
1- Lececo
2- RAK
3- Approved equal

Approeved material of mixers:
1- Grohe
2- Presto
3- Approved equal.