

PETRA GATE

Volume 1 – Conditions of Contract – “Re-measured Contract”

Volume 2 – Specification

Volume 3 – Bills of Quantities & Preambles

Volume 4 – Drawings

November 2012

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

This Technical Specifications of the Contract shall be the General Technical Specifications for Buildings (Volume I for Civil and Architectural Works), prepared by the Ministry of Public Works (1996 Version), and the General Specifications for Highways & Bridges prepared by MPW (1991 Version), and all addenda and amendments published up to date. All provisions of all clauses not specifically amended herein shall remain in full force and effect. It should be noted that the clauses of BOQ shall take precedence over the clauses of the General Technical Specifications. The Contractor shall provide the Employer (or his representative) with an original copy of the General Technical Specifications.

SPECIAL SPECIFICATIONS

DIVISION 1
GENERAL REQUIREMENTS

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SECTION 01010

Summary Of Work

PART 1 GENERAL

1.01 Work Covered By Contract Documents/Requirements Included

The Work of this Contract comprises but is not limited to the construction, completion and maintenance of **"Petra Gate – Jordan" / Structural, Finishes, Facades, Electromechanical and External Works** all as shown on the relevant drawings.

1.02 Related Requirements

- A. Instructions to Tenderers.
- B. Conditions of Contract.

1.03 Contracts

- A. Construct the Work under a "Re-measured" work contract.

END OF SECTION

SECTION 01039

Coordination and Meetings

PART 1 GENERAL

1.01 Section Includes

- A. Coordination
- B. Pre-construction meeting
- C. Site mobilization meeting
- D. Progress meetings

1.02 Related Sections

- A. Section 01041: Project Coordination: Coordination with Owner Representative

1.03 Coordination

- A. Coordinate scheduling, submittals, and Work of the various sections of the works to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

1.03 Coordination (Cont'd)

- C. Coordinate space requirements and installation of mechanical and electrical work, which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.04 Pre-construction Meeting

- A. Supervising Engineer/Owner's Representative will schedule a meeting after Notice of Award.
- B. Attendance Required: Supervising Engineer/Owner's Representative, and Contractor.
- C. Agenda:
 - 1) Execution of Owner-Contractor Agreement.
 - 2) Submission of executed bonds and insurance certificates.
 - 3) Distribution of Contract Documents.
 - 4) Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 - 5) Designation of personnel representing the parties in Contract, and the Supervising Engineer/Owner's Representative.
 - 6) Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract close-out procedures.
 - 7) Scheduling.
 - 8) Scheduling activities of a Geo-technical Engineer. (as required)

1.04 Pre-construction Meeting (Cont'd)

- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Supervising Engineer/Owner's Representative, Owner, participants, and those affected by decisions made.

1.05 Site Mobilization Meeting

- A. Supervising Engineer/Owner's Representative will schedule a meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required: Supervising Engineer/Owner's Representative, Special Consultant, Contractor, and major Subcontractors.
- C. Agenda:
 - 1) Use of premises by Owner and Contractor.
 - 2) Owner's requirements.
 - 3) Construction facilities and controls provided by Owner.
 - 4) Temporary utilities provided by Owner.
 - 5) Survey and building layout.
 - 6) Security and housekeeping procedures.
 - 7) Schedules.
 - 8) Procedures for testing.
 - 9) Procedures for maintaining record documents.
 - 10) Requirements for start-up of equipment.
 - 11) Inspection and acceptance of equipment put into service during construction period.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Supervising Engineer/Owner's Representative, Owner, participants, and those affected by decisions made.

1.06 Progress Meetings

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

1.06 Progress Meetings

- C. Attendance Required: Main Contractor, major Subcontractors and Suppliers, Owner, Supervising Engineer/Owner's Representative, as appropriate to agenda topics for each meeting.
- D. Agenda:
- 1) Review minutes of previous meetings.
 - 2) Review of Work progress.
 - 3) Field observations, problems, and decisions.
 - 4) Identification of problems which impede planned progress.
 - 5) Review of submittals schedule and status of submittals.
 - 6) Review of off-site fabrication and delivery schedules.
 - 7) Maintenance of progress schedule.
 - 8) Corrective measures to regain projected schedules.
 - 9) Planned progress during succeeding work period.
 - 10) Coordination of projected progress.
 - 11) Maintenance of quality and work standards.
 - 12) Effect of proposed changes on progress schedule and coordination.
 - 13) Other business relating to Work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Supervising Engineer/Owner's Representative, Owner, participants, and those affected by decisions made.

PART 2 PRODUCTS - NOT USED-

PART 3 EXECUTION - NOT USED -

END OF SECTION

SECTION 01041

Project Coordination

PART 1 GENERAL

1.01 Section Includes

- A. Project coordination by the Project Coordinator.
- B. Construction mobilization.
- C. Schedules.
- D. Submittals.
- E. Coordination drawings.
- F. Close-out procedures.

1.02 Related Sections

- A. General Conditions: Duties of the Supervising Engineer/Owner's Representative; unless otherwise noted.
- B. Section 01010: Summary of Work.
- C. Section 01700: Contract Close-out.

1.03 Project Coordinator

- A. Project Coordinator: Main Contractor.

1.04 Construction Mobilization

- A. Cooperate with the Supervising Engineer/Owner's Representative in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- B. During construction, coordinate use of site and facilities through the Supervising Engineer/Owner's Representative.
- C. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

1.04 Construction Mobilization (cont'd)

- D. Comply with instructions of the Supervising Engineer/Owner's Representative for use of temporary utilities and construction facilities.
- E. Coordinate field engineering and layout work under instructions of the Supervising Engineer/Owner's Representative.

1.05 Schedules

- A. Submit preliminary progress schedule in accordance with Section 01300, 01310 and coordinated with Project construction schedule.
- B. After review, revise and resubmit schedule to comply with revised Project schedule.
- C. During progress of work revise and resubmit as directed.

1.06 Submittals

- A. Submit preliminary shop drawings, product data and samples in accordance with Section 01300 for review and compliance with Contract Documents, for field dimensions and clearances, for relation to available space, and for relation to work of separate contracts. Revise and resubmit as required.
- B. Submit applications for payment on forms for review, and to Supervising Engineer/Owner's Representative.
- C. Submit requests for interpretation of Contract Documents, and obtain instructions through the Supervising Engineer/Owner's Representative.
- D. Process requests for substitutions, and change orders, through the Supervising Engineer/Owner's Representative.
- E. Deliver close-out submittals for review and preliminary inspection reports, to Supervising Engineer/Owner's Representative.

1.07 Coordination Drawings

- A. Provide information required by Supervising Engineer/Owner's Representative for preparation of coordination drawings.
- B. Review drawings prior to submission to Supervising Engineer/Owner's Representative.

1.08 Close-Out Procedures

- A. Notify Supervising Engineer/Owner's Representative when Work is considered ready for Substantial Completion.
- B. Comply with Supervising Engineer instructions to correct items of work listed in executed Certificates of Substantial Completion.
- C. Notify Supervising Engineer/Owner's Representative when Work is considered finally complete.
- D. Comply with Supervising Engineer/Owner's Representative's instructions for completion of items of Work determined by Supervising Engineer/Owner's Representative's final inspection.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01090

Reference Standards

PART 1 GENERAL

1.01 Requirements Included

- A. Abbreviations and acronyms used in Contract Documents to identify reference standards.

1.02 Quality Assurance

- A. *Application:* When a standard is specified by reference, comply with requirements and recommendations stated in that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
- B. *Publication Date:* The publication in effect on the date of issue of Contract Documents, except when a specific publication date is specified.

1.03 Abbreviations, Names, And Addresses Of Organizations

AA	Aluminum Association 818 Connecticut Avenue, N.W. Washington, DC 20006
AABC	Associated Air Balance Council 1000 Vermont Avenue, N.W. Washington, DC 20005
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, N.W. Washington, DC 20001
ACI	American Concrete Institute Box 19150 Reford Station Detroit, MI 48219
ADC	Air Diffusion Council 435 North Michigan Avenue Chicago, IL 60611
AI	Asphalt Institute Asphalt Institute Building College Park, MD 20740

1.03 Abbreviations, Names, And Addresses Of Organizations (cont'd)

AISC	American Institute of Steel Construction 1221 Avenue of the Americas New York, NY 10020
AISI	American Iron and Steel Institute 1000 16th Street, N.W. Washington, DC 20036
AMCA	Air Movement and Control Association 30 West University Drive Arlington Heights, IL 60004
ANSI	American National Standards Institute 1430 Broadway New York, NY 10018
ARI	Air-Conditioning and Refrigeration Institute 1815 North Fort Myer Drive Arlington, VA 22209
ASHRAE	American Society of Heating, Refrigerating and Conditioning Engineers 345 East 47th Street New York, NY 10017
ASME	American Society of Mechanical Engineers 345 East 47th Street New York, NY 10017
ASPA	American Sod Producers Association Association Building Ninth and Minnesota Hastings, NE 68901
ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
AWWA	American Water Works Association 6666 W. Quincy Avenue Denver, CO 80235
AWI	Architectural Woodwork Institute 2310 South Walter Reed Drive Arlington, VA 22206
AWPA	American Wood-Preservers' Association 7735 Old Georgetown Road Bethesda, MD 20014

1.03 Abbreviations, Names, And Addresses Of Organizations (cont'd)

AWS	American Welding Society 2501 NW 7th Street Miami, FL 33125
BSI	British Standards Institution 2 Park Street London W1A 2BS
CDA	Copper Development Association 57th Floor, Chrysler Building 405 Lexington Avenue New York, NY 10017
CRSI	Concrete Reinforcing Steel Institute 180 North LaSalle Street, Suite 2110 Chicago, IL 60601
DIN	Deutshes Institut Fur Normung Berlin, Koln
EN	European Norm
FM	Factory Mutual System 1151 Boston-Providence Turnpike Norwood, MA 02062
FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) Washington Navy Yard, Bldg. 197 Washington, DC 20407
GA	Gypsum Association 1603 Orrington Avenue Evanston, IL 60201
MFMA	Maple Flooring Manufacturers Association 2400 East Devon, Suite 205 Des Plaines, IL 60018
MIL	Military Specification Naval Publications and Forms Center 5801 Tabor Avenue Philadelphia, PA 19120
NAAMM	National Association of Architectural Metal Manufacturers 221 North LaSalle Street Chicago, IL 60601

1.03 Abbreviations, Names, And Addresses Of Organizations (cont'd)

NEBB	National Environmental Balancing Bureau 8224 Old Courthouse Road Vienna, VA 22180
NEMA	National Electrical Manufacturers' Association 2101 L Street, N.W. Washington, DC 20037
NFPA	National Fire Protection Association 470 Atlantic Avenue Boston, MA 02210
NFPA	National Forest Products Association 1619 Massachusetts Avenue, N.W. Washington, DC 20036
NSWMA	National Solid Wastes Management Association 1120 Connecticut Avenue, N.W. Washington, DC 20036
NTMA	National Terrazzo and Mosaic Association 3166 Des Plaines Avenue Des Plaines, IL 60018
PCA	Portland Cement Association 5420 Old Orchard Road Skokie, IL 20076
PS	Product Standard U.S. Department of Commerce Washington, DC 20203
SDI	Steel Deck Institute Box 3812 St. Louis, MO 63122
SDI	Steel Door Institute 712 Lakewood Center North Cleveland, OH 44107
SIGMA	Sealed Insulating Glass Manufacturers Association 111 East Wacker Drive Chicago, IL 60601
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 8224 Old Court House Road Vienna, VA 22180

1.03 Abbreviations, Names, And Addresses of Organizations (cont'd)

TAS Technical Aid Series
 Construction Specifications Institute
 1150 Seventeenth Street, N.W.
 Washington, DC 20036

UL Underwriters' Laboratories, Inc.
 333 Pfingston Road
 Northbrook, IL 60062

RSS Royal Scientific Society
 Amman-Jordan

END OF SECTION

SECTION 01100

Alternates

PART 1 GENERAL

1.01 Requirements Included

- A. Identification and description of Alternate work.

1.02 Related Requirements

- A. Contract Documents.
- B. Sections of Specifications identified in each Alternate.

1.03 Procedures

- A. Alternates will be exercised at the option of Supervising Engineer/Owner's Representative.
- B. Coordinate related work and modify surrounding work as required to complete the Work, including changes under each Alternate, when acceptance is designated in Owner-Contractor Agreement.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01300

Submittals

PART 1 GENERAL

1.01 Section Includes

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed Products list.
- D. Shop Drawings.
- E. Product Data.
- F. Samples.

1.02 Related Sections

- A. Section 01400 Quality Control.
- B. Section 01700 Contract Close-out.

1.03 Submittal Procedures

- A. Transmit each submittal with an approved transmittal form to the Supervising Engineer / Owner's Representative.
- B. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- C. Identify Project, Contractor, Subcontractor or Supplier; pertinent drawing and detail number, and specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

1.03 Submittal Procedures (cont'd)

- E. Schedule submittals to expedite the Project, and deliver to Supervising Engineer/Owner's Representative at Site Office. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from the contractor.
- G. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
- H. Provide space for Contractor and Supervising Engineer/Owner's Representative review stamps.
- I. Revise and resubmit, identify all changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.
- K. Submittals not requested will not be recognized or processed.

1.04 Proposed Products List

- A. Within 30 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.05 Shop Drawings

- A. Submit in the form of one reproducible and the number of opaque reproductions which Contractor requires, plus two copies which will be retained by Supervising Engineer/Owner's Representative.
- B. Shop Drawings: Submit for review. After review, produce copies and distribute in accordance with the SUBMITTAL PROCEDURES article above and for record documents purposes described in Section 01700 - CONTRACT CLOSE-OUT.
- C. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.06 Product Data

- A. Submit the number of copies which the Contractor requires, plus two copies which will be retained by the Supervising Engineer and one copy for the Owner's Representative.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. After review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01700 - CONTRACT CLOSE-OUT.

1.07 Samples

- A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- B. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Supervising Engineer/Owner's Representative selection.
- C. Include identification on each sample, with full Project information.
- D. Submit the number of samples specified in individual specification sections; one of which will be retained by Supervising Engineer/Owner's Representative.
- E. Reviewed samples which may be used in the Work are indicated in individual specification sections.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01310

Progress Schedules

PART 1 GENERAL

1.01 Section Includes

- A. Format.
- B. Content.
- C. Revisions to schedules.
- D. Submittals.

1.02 Related Sections

- A. Section 01010 - Summary of Work.
- B. Section 01300 - Submittals: Shop drawings, product data, and samples and schedule of values.

1.03 Format

- A. Prepare network analysis system using the critical path method, as outlined in The Associated General Contractors of America (AGC) publication "The Use of CPM in Construction - A Manual for General Contractors". (Using Primavera)
- B. Sequence of Listings: The chronological order of the start of each item of Work.
- C. Scale and Spacing: To provide space for notations and revisions.
- D. Sheet Size: Minimum 560 x 432 mm or Multiples of 8-1/2 x 11 inches.

1.04 Content

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and/or separate floors and other logically grouped activities.

1.04 Content (cont'd)

- D. Provide sub-schedules for each stage of Work identified in Section 01010.
- E. Provide sub-schedules to define critical portions of the entire schedule.
- F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- G. Provide separate schedule of submittal dates for shop drawings, product data, and samples, including dates reviewed submittals will be required from Engineer. Indicate decision dates for selection of finishes.

1.05 Revisions To Schedules

- A. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
- B. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
- C. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including the effect of changes on schedules of separate contractors.

1.06 Submittals

- A. Submit preliminary outline Schedules within 15 Days After Date Of Owner-Contractor Agreement For Coordination With Work Of separate contracts. After review, submit detailed schedules within 15 days modified to accommodate revisions recommended by Supervising Engineer/Owner's Representative.

1.07 Distribution

- A. Distribute copies of reviewed schedules to Project site file, Subcontractors, suppliers, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

PART 2 PRODUCTS Not Used

PART 3 EXECUTION Not Used

END OF SECTION

SECTION 01340

Shop Drawings, Product Data and Samples

PART 1 GENERAL

1.01 Requirements Included

- A. Submit Shop Drawings, Product Data and Samples required by Contract Documents.

1.02 Related Requirements

- A. Definitions and Additional Responsibilities of Parties: Conditions of the Contract.
- B. Section 01720: Project Record Documents
- C. Designate in the construction schedule, or in a separate coordinated schedule, the dates for submission and the dates that reviewed Shop Drawings, Product Data and Samples will be needed.

1.03 Shop Drawings

- A. Drawings shall be presented in a clear and thorough manner.
 - 1. Details shall be identified by reference to sheet and detail, schedule or room numbers shown on Contract Drawings.

1.04 Product Data

- A. Preparation
 - 1. Clearly mark each copy to identify pertinent products or models.
 - 2. Show performance characteristics and capacities.
 - 3. Show dimensions and clearances required.
 - 4. Show wiring or piping diagrams and controls.
- B. Manufacturer's standard schematic drawings and diagrams:
 - 1. Modify drawings and diagrams to delete information which is not applicable to the Work.
 - 2. Supplement standard information to provide information specifically applicable to the Work.

1.05 Samples

- A. Office samples shall be of sufficient size and quantity to clearly illustrate:
 - 1. Functional characteristics of the product, with integrally related parts and attachment devices.
 - 2. Full range of color, texture and pattern.
- B. Field samples and mock-ups:
 - 1. Contractor shall erect, at the Project site, at a location acceptable to the Supervising Engineer/Owner's Representative.
 - 2. Size or area: that specified in the respective specification section.
 - 3. Fabricate each sample and mockup complete and finished.
 - 4. Remove mock-ups at conclusion of Work or when acceptable to the Supervising Engineer/Owner's Representative.

1.06 Contractor Responsibilities

- A. Review Shop Drawings, Product Data and Samples prior to submission.
- B. Determine and verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
 - 4. Conformance with specifications.
- C. Coordinate each submittal with requirements of the Work and of the Contract Documents.
- D. Notify the Supervising Engineer/Owner's Representative in writing, at time of submission, of any deviations in the submittals from requirements of the Contract Documents.
- E. Begin no fabrication or work which requires submittals until return of submittals with the Supervising Engineer/Owner's Representative approval.

1.07 Submission Requirements

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Number of submittals required:
 - 1. All in accordance with Contract Documents.
- C. Submittals shall contain:
 - 1. All in accordance with Contract Documents.

1.08 Re-submission Requirements

- A. Make any corrections or changes in the submittals required by the Supervising Engineer/Owner's Representative and resubmit until approved.
- B. Shop Drawings and Product Data:
 - 1. Revise initial drawings or data, and resubmit as specified for the initial submittal.
 - 2. Indicate any changes which have been made other than those requested by the Supervising Engineer/Owner's Representative.
- C. Samples: Submit new samples as required for initial submittal.

1.09 Distribution

- A. Distribute reproductions of Shop Drawings and copies of Product Data which carry the Supervising Engineer/Owner's Representative stamp of approval to:
 - 1. Job site file.
 - 2. Record Documents file.
 - 3. Other affected contractors.
 - 4. Subcontractors.
 - 5. Supplier or Fabricator.
 - 6. As directed by the Supervising Engineer/Owner's Representative.
- B. Distribute samples which carry the Supervising Engineer/Owner's Representative stamp of approval as directed by the Supervising Engineer/Owner's Representative.

1.10 Supervising Engineer/Owner's Representative Duties

- A. Review submittals with reasonable promptness and in accordance with schedule.
- B. Affix stamp and initials or signature, and indicate requirements for re-submittal, or approval of submittal.
- C. Return submittals to Contractor for distribution, or for re-submission.

END OF SECTION

SECTION 01380

Construction Photographs

PART 1 GENERAL

1.01 Requirements Included

- A. Employ competent photographer to take construction record photographs periodically during course of the Work.

1.02 Related Requirements

- A. Section 01010: Summary of Work.
- B. Section 01720: Project Record Documents.

1.03 Photography Required

- A. Provide photographs taken on cutoff date for each scheduled Application for Payment.
- B. Provide photographs taken at each major stage of construction:
 - 1. Completion of excavations.
 - 2. Completion of foundations.
 - 3. Completion of Different phases
- C. Views and Quantities Required:
 - 1. At each specified time, photograph Project from three different views, as approved by Supervising Engineer/Owner's Representative.
 - 2. Provide three prints of each view.

1.04 Costs Of Photography

- A. Pay costs for specified photography and prints.

PART 2 PRODUCTS

2.01 Prints

- A. Colored:
 - 1. Paper: Single weight, Neutral black image tone, white base.
 - 2. Finish: Smooth surface, glossy.
 - 3. Size: 200 x 250mm.

- B. Identify each print on back, listing:
 - 1. Name of Project.
 - 2. Orientation of view.
 - 3. Date and time of exposure.
 - 4. Name and address of photographer.
 - 5. Photographer's numbered identification of exposure.

2.02 Digital Copies

PART 3 EXECUTION

3.01 Technique

- A. Factual presentation.

- B. Correct exposure and focus.
 - 1. High resolution and sharpness.
 - 2. Maximum depth-of-field.
 - 3. Minimum distortion.

3.02 Views Required

- A. Photograph from locations to adequately illustrate condition of construction and state of progress.
 - 1. At successive periods of photography, take at least one photograph from the same overall view as previously.
 - 2. Consult with Supervising Engineer/Owner's Representative at each period of photography for instructions concerning views required.

3.03 Delivery of Prints

- A. Deliver prints and digital copies to the Supervising Engineer/Owner's Representative to accompany each Application for Payment.

- B. Deliver prints and digital copies as soon as processed, one set each to:
 - 1) Owners Representative.
 - 2) The Supervising Engineer
 - 3) Project Record File.

END OF SECTION

SECTION 01400

Quality Control

PART 1 GENERAL

1.01 Requirements Included

- A. General Quality Control.
- B. Mock-ups.
- C. Manufacturers' Field Services.

1.02 Related Requirements

- A. Conditions of the Contract: Inspection and testing required by governing authorities.

1.03 Quality Control, General

- A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

1.04 Mock-Up

- A. Erect field Samples and Mock-ups at Project site in accordance with requirements of the Specification section.
- B. Provide travel facilities for the Supervising Engineer/Owner's Representative where necessary to inspect samples or materials inside or outside Jordan.

1.05 Manufacturers' Field Services

- A. When specified in respective Specification sections, require supplier or manufacturer to provide qualified personnel to observe field conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment as applicable, and to make appropriate recommendations.
- B. Representative shall submit written report to Supervising Engineer/Owner's Representative listing observations and recommendations.

END OF SECTION

SECTION 01410

Testing Laboratory Services

PART 1 GENERAL

1.01 Requirements Included

- A. Contractor shall employ and pay for the services of an Independent Testing Laboratory to perform specific services and testing.

1.02 Related Requirements

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or approvals of public authorities:
- B. Related Requirements Specified in Other Sections:
- C. Respective sections of specifications: Certification of products.
- D. Each specification section listed: Laboratory tests required, and standards for testing.
- E. Testing Laboratory inspection, sampling and testing is required as elsewhere indicated in Contract Documents.

1.03 Qualification Of Laboratory

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", published by American Council of Independent Laboratories.
- B. Meet basic requirements of ASTM E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."
- C. Authorized to operate in Jordan.
- D. Testing Equipment:
 - 1. Calibrated at reasonable intervals by devices of accuracy traceable to either:
 - a. National Bureau of Standards.
 - b. Accepted values of natural physical constants.

1.04 Laboratory Duties

- A. Cooperate with the Supervising Engineer/Owner's Representative and Contractor; provide qualified personnel after due notice.
- B. Perform specified inspections, sampling and testing of materials and methods of construction:
 - 1. Comply with specified standards.
 - 2. Ascertain compliance of materials with requirements of Contract Documents.
- C. Promptly notify the Supervising Engineer/Owner's Representative and Contractor of observed irregularities or deficiencies of work or products.
- D. Promptly submit five copies of written report of each test and inspection to Supervising Engineer/Owner's Representative. Each report shall include:
 - 1. Date of test.
 - 2. Project title and number.
 - 3. Testing laboratory name, address and telephone number.
 - 4. Name and signature of laboratory inspector.
 - 5. Date and time of sampling or inspection.
 - 6. Record of temperature and weather conditions.
 - 7. Date of test.
 - 8. Identification of product and specification section.
 - 9. Location of sample or test in the Project.
 - 10. Type of inspection or test.
 - 11. Results of tests and compliance with Contract Documents.
 - 12. Interpretation of test results, when requested by the Supervising Engineer/Owner's Representative.
- E. Perform additional tests as required by the Supervising Engineer/Owner's Representative or the Owner.

1.05 Limitations Of Authority Of Testing Laboratory

- A. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirements of Contract Documents.
 - 2. Approve or accept any portion of the Work.
 - 3. Perform any duties of the Contractor.

1.06 Contractor's Responsibilities

- A. Cooperate with laboratory personnel, provide access to Work, to Manufacturer's operations.
- B. Secure and deliver to the laboratory adequate quantities of representational samples of materials proposed to be used and which require testing.
- C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.
- D. Furnish copies of Products test reports as required.
- E. Furnish incidental labor and facilities:
 - 1. To provide access to Work to be tested.
 - 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
 - 3. To facilitate inspections and tests.
 - 4. For storage and curing of test samples.
- F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
 - 1. When tests or inspections cannot be performed after such notice, reimburse Owner for laboratory personnel and travel expenses incurred due to Contractor's negligence.
- G. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required:
 - 1. For the Contractor's convenience.
 - 2. When initial tests indicate Work does not comply with Contract Documents.
- H. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's convenience.
- I. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required when initial tests indicate Work does not comply with Contract Documents.

END OF SECTION

SECTION 01500

Construction Facilities and Temporary Controls

PART 1 GENERAL

1.01 Requirements Included

- A. Electricity, Lighting.
- B. Heat, Ventilation.
- C. Telephone Service.
- D. Water.
- E. Sanitary Facilities.
- F. Construction Aids.
- G. Enclosures.
- H. Cleaning During Construction.
- I. Project Identification.
- J. Field Offices and Sheds.
- K. Removal.

1.02 Related Requirements

- A. Section 01010 - Summary of Work
- B. Section 01700 - Contract Close-out

1.03 Electricity, Lighting

- A. Provide service required for construction operations, with branch wiring and distribution boxes located to allow service and lighting by means of construction type power cords.
- B. Provide lighting for construction operations.

1.04 Heat, Ventilation

- A. Provide as required to maintain specified conditions for construction operations, to protect materials and finishes from damage due to temperature or humidity.
- B. Provide ventilation of enclosed areas to cure materials, to disperse humidity, and to prevent accumulations of dust, fumes, vapors, or gases.

1.05 Telephone Service

- A. Provide telephone service and fax to field offices, as described in Conditions of Contract.

1.06 Water

- A. Provide service required for construction operations. Extend branch piping with outlets located so that water is available by use of hoses.

1.07 Sanitary Facilities

- A. Provide and maintain required facilities and enclosures, as described in Conditions of Contract.

1.08 Construction Aids

- A. Provide construction aids and equipment required by personnel and to facilitate execution of the Work: Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment.

1. Refer to respective sections for particular requirements for each trade.

- B. Provide adequate first aid facilities on site.

1.09 Enclosures

- A. Provide temporary weather-tight closures of openings in exterior surfaces to provide acceptable working conditions and protection for materials, to allow for temporary heating, and to prevent entry of unauthorized persons. Provide doors with self-closing hardware and locks.

1.10 Cleaning During Construction

- A. Control accumulation of waste materials and rubbish; periodically dispose of off-site.
- B. Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

1.11 Project Identification

- A. Provide Project identification sign of steel frame construction, with steel plate painted, with exhibit lettering by professional sign painter, to the Supervising Engineer/Owner's Representative's design and colors. List title of Project, name of Owner, Supervising Engineer / Consultant, and Contractors.
- B. Erect on site at each entrance to site, location to be established by the Supervising Engineer/Owner's Representative.
- C. Allow no other signs to be displayed, as described in the Conditions of Contract.

1.12 Field Offices and Sheds

- A. Submit office block layout for the Consultant/Owner's Representative for approval prior to construction, as described in conditions of contract.
- B. Construct, and/or rent and furnish and maintain an office block at the project site or adjacent to site for the Owner's Representative's/Consultant supervisory staff Construction to be air conditioned, weather-tight, with lighting, electrical outlets, heating, cooling and ventilating equipment as described in the Conditions of Contract.
- C. Provide the all consumables, equipment office furniture and printed matter to the supervisory staff for the full and complete duration of the contract as described in the Conditions of Contract.
- D. Storage Sheds for Tools, Materials, and Equipment: Weather-tight, with heat and ventilation for Products requiring controlled conditions, with adequate space for organized storage and access, and lighting for inspection of stored materials.
- E. The Contractor shall employ an office boy for the Consultant/Owner's Representatives offices at his own expense.

1.13 Removal

- A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection.
- B. Clean and repair damage caused by installation or use of temporary facilities. Remove underground installations; grade site as indicated. Restore existing facilities used during construction to specified, or to original, condition.

END OF SECTION

SECTION 01600

Material and Equipment

PART 1 GENERAL

1.01 Requirements Included

- A. Products.
- B. Workmanship.
- C. Manufacturers' Instructions.
- D. Transportation and Handling.
- E. Storage and Protection.

1.02 Related Requirements

- A. Section 01010 - Summary of Work
- B. Section 01700 - Contract Close-out

1.03 Products

- A. Products include material, equipment, and systems.
- B. Comply with Specifications and referenced standards as minimum requirements.
- C. Components required to be supplied in quantity within a Specification section shall be the same, and shall be interchangeable.

1.04 Workmanship

- A. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform work by persons qualified to produce workmanship of specified quality.
- C. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.05 Manufacturers' Instructions

- A. When work is specified to comply with manufacturers' instructions, submit copies as specified in Conditions of Contract, distribute copies to persons involved, and maintain one set in field office.
- B. Perform work in accordance with details of instructions and specified requirements. Should a conflict exist between Specifications and instructions, consult with the Supervising Engineer/Owner's Representative.

1.06 Transportation And Handling

- A. Transport Products by methods to avoid Product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.
- B. Provide equipment and personnel to handle Products by methods to prevent soiling or damage.
- C. Promptly inspect shipments to assure that Products comply with requirements, quantities are correct, and Products are undamaged.

1.07 Storage And Protection

- A. Store Products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive Products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.
- B. For exterior storage of fabricated Products, place on sloped supports above ground. Cover Products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
- D. Arrange storage to provide access for inspection. Periodically inspect to assure Products are undamaged, and are maintained under required conditions.
- E. After installation, provide coverings to protect Products from damage from traffic and construction operations, remove when no longer needed.

END OF SECTION

SECTION 01630

Substitutions and Product Options

PART 1 GENERAL

1.01 Requirements Included

- A. Furnish and install Products specified, under options and conditions for substitutions stated in this Section.

1.02 Related Requirements

- A. Section 01400: Quality Control.
- B. Section 01720: Project Record Documents.

1.03 Products List

- A. Within 30 days after award of Contract, submit to the Supervising Engineer/Owner's Representative five copies of complete list of major products which are proposed for installation.
- B. Tabulate Products by specification section number and title.
- C. For products specified only by reference standards, list for each such Product:
 - 1. Name and address of manufacturer.
 - 2. Trade name.
 - 3. Model or catalog designation.
 - 4. Manufacturer's data:
 - a. Reference standards:
 - b. Performance test data.

1.04 Contractor's Options

- A. For Products specified only by reference standard, select Product meeting that standard, by any manufacturer.
- B. For Products specified by naming several Products or manufacturers, select any one of products and manufacturers named which complies with Specifications.

1.05 Substitutions

- A. Within a period of 30 days after award of Contract, the Supervising Engineer/Owner's Representative will consider formal requests from the Contractor for substitution of Products in place of those specified.
 - 1. After end of that period, requests will be considered only in case of Product unavailability or other conditions beyond the control of Contractor.

- B. Submit separate request for each substitution. Support each request with:
 - 1. Complete data substantiating compliance of proposed substitution with requirements stated in Contract Documents:
 - a. Product identification, including manufacturer's name and address.
 - b. Manufacturer's literature; identify:
 - 1) Product description.
 - 2) Reference standards.
 - 3) Performance and test data.
 - c. Samples, as applicable.
 - d. Name and address of similar projects on which product has been used, and date of each installation.
 - 2. Itemized comparison of the proposed substitution with product specified; List significant variations.
 - 3. Data relating to changes in construction schedule.
 - 4. Any effect of substitution on separate contracts.
 - 5. List of changes required in other work or Products.
 - 6. Accurate cost data comparing proposed substitution with product specified.
 - a. Amount of any net change to Contract Sum.
 - 7. Designation of required license fees or royalties.
 - 8. Designation of availability of maintenance services, sources of replacement materials.

- C. Substitutions will not be considered for acceptance when:
 - 1. They are indicated or implied on shop drawings or product data submittals without a formal request from Contractor.
 - 2. They are requested directly by a subcontractor or supplier.
 - 3. Acceptance will require substantial revision of Contract Documents.

1.05 Substitutions (cont'd)

- D. Substitute products shall not be ordered or installed without written acceptance of the Supervising Engineer/Owner's Representative.
- E. The Supervising Engineer/Owner's Representative will determine acceptability of proposed substitutions.

1.06 Contractor's Representation

- A. In making formal request for substitution Contractor represents that:
 - 1. He has investigated proposed product and has determined that it is equal to or superior in all respects to that specified.
 - 2. He will provide same warranties or bonds for substitution as for product specified.
 - 3. He will coordinate installation of accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.
 - 4. He waives claims for additional costs caused by substitution which may subsequently become apparent.
 - 5. Cost data is complete and includes related costs under his Contract, but not:
 - a. Costs under separate contracts.
 - b. The Supervising Engineer's costs for redesign or revision of Contract Documents.

1.07 Supervising Engineer/Owner's Representative Duties

- A. Review Contractor's requests for substitutions with reasonable promptness.
- B. Notify Contractor, in writing, of decision to accept or reject requested substitution.

END OF SECTION

SECTION 01700

Contract Close-Out

PART 1 GENERAL

1.01 Requirements Included

- A. Close-out Procedures.
- B. Final Cleaning.
- C. Warranties and Bonds.

1.02 Related Requirements

- A. Conditions of the Contract.
- B. Section 01500 - Construction Facilities and Temporary Controls: Cleaning during construction.

1.03 Close-Out Procedures

- A. Comply with procedures stated in General Conditions of the Contract for issuance of Certificate of Substantial Completion.
- B. When Contractor considers Work has reached final completion, submit written certification that Contract Documents have been reviewed, work has been inspected, and that Work is complete in accordance with Contract Documents and ready for the Supervising Engineer/Owner's Representative's inspection.
- C. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.
- D. The Supervising Engineer/Owner's Representative will issue a final change order reflecting approved adjustments to Contract Sum not previously made by Change Order.

1.04 Final Cleaning

- A. Execute prior to final inspection.
- B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition, clean or replace filters of mechanical equipment. Clean roofs, gutters, down spouts, and drainage systems.
- C. Clean site; sweep paved areas, rake clean other surfaces.
- D. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site. Owner will provide final cleaning after final acceptance.

1.05 Warranties And Bonds

- A. Provide duplicate, notarized copies. Execute Contractor's submittals and assemble documents executed by subcontractors, suppliers, and manufacturers. Provide table of contents and assemble in binder with durable plastic cover.
- B. Submit material prior to final application for payment. For equipment put into use with Owner's permission during construction, submit within 10 days after first operation. For items of Work delayed materially beyond Date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

END OF SECTION

SECTION 01710

Cleaning

PART 1 GENERAL

1.01 Requirements Included

- A. Execute cleaning, during progress of the Work, and at completion of the Work.

1.02 Related Requirements

- A. Conditions of the Contract.
- B. Each Specification Section: Cleaning for specific Products or work.

1.03 Disposal Requirements

- A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

2.01 Materials

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 During Construction

- A. Execute periodic cleaning to keep the Work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from demolition works, and construction operations.
- B. Provide on-site containers for the collection of waste materials, debris and rubbish.

3.01 During Construction (Cont'd)

- C. Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

END OF SECTION

SECTION 01720

Project Record Documents

PART 1 GENERAL

1.01 Requirements Included

- A. Maintain at the site for the Owner one record copy of:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Supervising Engineer/Owner's Representative Field Orders or written instructions.
 - 6. Approved Shop Drawings, Product Data and Samples.
 - 7. Field Test records.
 - 8. Construction photographs.

- B. As-Built Drawings

1.02 Related Requirements

- A. Conditions of Contract.
- B. Section 01340: Shop Drawings, Product Data and Samples.
- C. Section 01380: Construction Photographs.

1.03 Maintenance Of Documents And Samples

- A. Store documents and samples in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide locked cabinet or secure storage space for storage of samples.

- B. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

- C. Make documents and samples available at all times for inspection by the Supervising Engineer/Owner's Representative.

1.03 Maintenance Of Documents And Samples (Cont'd)

D. Materials

The materials required for maintenance to be submitted after Provisional Acceptance of the work.

1. Shop drawings for all the work to be submitted.
2. As-built drawings/documentation shall be submitted as follows:-
 - i. One polyester copy and 6 paper copies of each drawing duly checked and approved by the Supervising Engineer/Owner's Representative.
 - ii. CD of all drawings/documentation.
3. Three original sets of operation/maintenance manual.
4. Three sets each of any other documents required.

1.04 Marking Devices

- A. Provide felt tip marking pens for recording information in the color code designated by the Supervising Engineer/Owner's Representative.

1.05 Recording

- A. Label each document "PROJECT RECORD" in neat large printed letters.
- B. Record information concurrently with construction progress.
 1. Do not conceal any work until required information is recorded.
- C. Drawings; Legibly mark to record actual construction:
 1. Depths of various elements of foundation in relation to finish first floor datum.
 2. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Location of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
 4. Field changes of dimension and detail.
 5. Changes made by Field Order or by Change Order.
 6. Details not on original contract drawings.

1.05 Recording

- D. Specifications and Addenda; Legibly mark each Section to record:
 - 1. Manufacturer, trade name, catalog number, and Supplier of each Product and item of equipment actually installed.
 - 2. Changes made by Field Order or by Change Order.
- E. Refer to attachment to this Section of Specifications for general guidelines in preparation of record documents.

1.06 Submittal

- A. At Contract close-out, deliver Record Documents to the Supervising Engineer/Owner's Representative.
- B. Accompany submittal with transmittal letter in duplicate, containing:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and address.
 - 4. Title and number of each Record Document.
 - 5. Signature of Contractor or his authorized representative.

END OF SECTION

DIVISION 2
SITE WORKS

Ref.	Description	Page No.		
02100	Excavation and Earthworks	02100-01	thru	02100-08

SECTION 02100

Excavations and Earthworks

1.01 Scope of Work

The Contractor shall provide all requisite equipment, labor and materials, necessary for executing the excavation works, in a manner that will meet the Supervising Engineer/Owner's Representative's acceptance and approval.

The work to be carried out by the Contractor, shall include, not by way of limitation, but in amplification to what is shown on the drawings and /or, the existing site conditions and/or the structural engineering requirements, or all, for the full and proper execution of the proposed Project, the following:

- A. Stock piling of the suitable excavated soil for back-filling.
- B. Loading and carting away of surplus and /or unsuitable excavated material, and the disposal of same to an approved dumping area.
- C. Approved stone hard core material under concrete slabs on grade.
- D. Approved imported fill material for backfilling around foundations, walls etc., as required.

1.02 Inspection Of The Site Documents

- A. The Report on Geotechnical Investigations for the Project Site (Which includes the results of the field and laboratory investigation, geotechnical analysis and interpretation of the findings, and conclusions and recommendations to aid the design and construction of foundations) may be inspected at the Engineer's office. This inspection shall be for the Contractor's information and guidance only, but without guarantee of accuracy, and therefore does not form part of the Contract Documents.
- B. No claim for extra compensation or extension of time will be allowed on account of subsurface conditions inconsistent with the data given in the Report on "Geotechnical Investigations" or for want of knowledge of the Site or the nature of the sub-soil.
- C. The Contractor shall visit the Site and make all investigation which he deems necessary to ascertain the nature of the existing ground and the sub-soil to be excavated, and shall if he wishes to do so, drill as much boreholes as he deems necessary to satisfy himself as to the form and nature of the sub soil, and the existing site conditions in general.
- D. The plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period, as no additional compensation will be made for errors or inaccuracies that may be found therein.
- E. Based on the above mentioned Site investigations, the Contractor shall be responsible for checking the foundation's design and for redesigning any section, preparing Shop Drawings for the Supervising Engineer/Owner's Representative review and approval.

1.03 Profiles

The Contractor shall provide and erect profiles, templates, sight rails and the like and properly set out the proposed works from the base lines, levels, coordinates or datum given by the Engineer, and/or indicated on the drawings, or both.

1.04 Bench Marks

Establish permanent bench marks determined by an approved land surveyor or professional civil engineer. Maintain all established bounds and bench marks and replace as directed those which are destroyed or disturbed due to the excavation operations, at no cost to the Owner.

1.05 Site Survey

- A. As soon as the Site is handed over to the Contractor, and before commencing any excavation works, the Contractor shall at his own expense, carry out a check on the Site survey submitted by the Owner for the whole project Site; prepare and submit for the Engineer's approval a grid plan; the grid sides shall be 1 meter with levels taken at the corners, and all levels shall be referred to the approved bench mark; verify all levels and dimensions and notify the Engineer in writing of any discrepancies. Do not proceed with excavation works until discrepancies have been corrected and are acceptable to the Engineer.
- B. The Contractor shall also be responsible for the accurate setting out of excavations and for keeping all reference axes and bench marks reasonably clear, and far from the working area.

PART 2 PREPARATION

2.01 Site Clearance

- A. The Contractor shall carry out Site clearance which shall include clearing out the whole site area of all kinds of vegetation, debris, rubbish, etc., including the grubbing out of roots, including loading and carting away to an approved dumping area prior to any site preparation and /or setting - out is begun.

2.02 Preparation and Setting - Out

- A. Before any particular excavation is begun, the Contractor shall submit for the Engineer's approval his proposals for marking the area to be excavated and for controlling the depth and profile of the excavation to the dimensions and levels shown on the drawings. The Contractor shall give the Engineer not less than 24 hours notice in writing of his intention to set out the works to enable the Engineer to make arrangements for checking. The check by the Engineer shall in no way absolve the Contractor from his responsibility for setting-out the Works correctly.
- B. Establish extent of excavation by area and elevation; designate and identify datum elevation.
- C. Set required lines and levels.
- D. Maintain bench marks, and other reference points.

PART 3 EXECUTIONS

3.01 Excavations Generally

- A. Excavation works shall be carried out in any type of soil met with during the course of excavation, whether earth, clay, gravel, sand, conglomerates, boulders, solid rock or any other material to any depth, as shown on the drawings or as directed and instructed by the Engineer.
- B. Where excavation works are carried out by power excavating equipment such as bulldozers, power shovels and back-hoes, power drills, or any other equipment which the Contractor may propose to use, sufficient depth shall be left unexcavated to enable the exact depth required to be obtained by hand excavation.
- C. Excavations shall be to the lines, levels and dimensions indicated on the drawings, or instructed by the Engineer.
- D. All foundations shall be placed on undisturbed soil.
- E. Should any excavation be made below the levels shown on the drawings, or those required by the Engineer, the excess depth of excavation shall be filled with concrete of 15 Mpa characteristic compressive strength, at the contractor's own expense.
- F. The use of explosives on site is strictly forbidden, and in no case shall the Contractor or his employees revert to the use of explosives of whatever type of size.
- G. The Contractor shall keep the area around excavations clear for a distance of one and half meter in all directions until concrete is placed and has set.
- H. The bottom of footings and foundation excavations shall be cut true to level and kept clean of loose material and debris at all times. Bottoms of excavations will be inspected and approved by the Engineer before foundations or pipes are laid.
- I. The Contractor will be held responsible for upholding the sides of excavations, and no claim for additional excavations, concrete, or other material will be considered in this respect, notwithstanding the methods the Contractor elects to adopt for upholding the sides of excavation.

3.02 Excavation's Safety

- A. All excavation works shall be carried out in a safe manner to the lines and levels shown on the drawings or to such lines and levels as the Engineer may direct as the work proceeds, depending on the nature of the ground exposed. The Contractor shall provide timbering, or use other approved methods to support the sides of excavations in such a way as to minimize ground movement.
- B. The Contractor shall be responsible for all safety measures needed to support the sides of the excavations for the safety of workers in particular and the works in general.

3.02 Excavation's Safety (cont'd)

- C. The from time-to-time directions by the Engineer shall not relieve the Contractor of his Contractual obligations to maintain the sides of excavation's safety and to ensure safety of the workers and the works.

3.03 Reducing Levels

- A. All excavations for reducing levels shall be carried out to the lines and levels shown on the drawings or to such lines and levels as ordered by the Engineer.
- B. If, from any cause whatsoever, excavations are carried out beyond their true line and level other than that ordered by the Engineer, the Contractor shall, at his own cost make good to the required lines and levels with mass concrete as instructed by the Supervising Engineer/Owner's Representative .
- C. All Excavations shall be performed so that the works are continually and effectively drained.

3.04 Inspection

- A. All Excavations shall be inspected and approved by the Engineer as the work proceeds and/or upon completion.
- B. The Contractor shall advise the Engineer with adequate time when the excavation, or part thereof, is ready for such inspection. The Contractor must not proceed with other phases until excavations have been inspected and/or authorized by the Engineer.

3.05 Haulage And Transportation Of Excavated Materials

- A. The Contractor shall regulate the loading and carting away of excavated materials, debris, rubbish, etc. day by day, to an approved dumping area, as the excavation works precede.

3.06 Excavations For Utility Trenches

- A. Trenches shall be of the necessary width for proper laying of utilities. The banks of pipe trenches shall be as nearly vertical and practicable. Care shall be taken not to over-excavate. The bottom of the trenches shall have a sand cushion accurately graded to provide uniform bearing and support for each section of the pipe laid on the sand cushion at every point along its entire length, except for those portions of the pipe sections where it is necessary to provide for bell holes and for the proper sealing of pipe joints.
- B. Bell holes and depressions for joints shall be dug after the trench bottom has been filled and graded in order that the pipe rests on the prepared bottom for as near its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required for properly making the particular type of joint.

3.06 Excavations For Utility Trenches (cont'd)

- C. Stones shall be removed as necessary to avoid point bearing. In rock areas, excavations will require the use of mechanically operated drills or other equipment for removal. Except as hereinafter specified for wet or otherwise unstable material, over excavated depths shall be backfilled with material specified for backfilling the lower portion of trenches.
- D. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe, as determined by the Engineer, is encountered at the bottom of the trench, such material shall be removed to the depth needed and the trenches.
- E. Trenches shall be constructed to the line and grade indicated on the drawings. Should it become necessary to change the position of the trench, the Engineer shall be notified.

3.07 Fill And Backfill Material For Structures

A. Material

- 1) The Contractor shall preserve a stockpile of suitable material for use as backfill, taken from the deeper site cuts during excavations and as approved by the Engineer. This approved material shall be used exclusively as fill material in all cases where site soils are to be used as fill.
- 2) Suitable fill material shall be of such character that it will compact to form a hard, dense, stable fill of good bearing quality. Fill soils shall not contain brush, rubble, and/or other perishable materials; any rocks or stones of sufficient size to interfere with the compacting equipment must be removed. The fill should also be free from detrimental quantities of top-soil, clay and shale that will disintegrate into clay under watering and rolling.
- 3) Should suitable fill material be not sufficient for this purpose the Contractor shall obtain supplementary quantities as required from other sources at his own expense.

B) Placement

- 1) Backfill shall be moistened or dried as may be required to obtain a moisture content suitable for compaction.
- 2) Backfill shall be placed in layers not exceeding 20cms. In depth prior to compaction, and shall be tamped in such lifts, using mechanical tamping equipment. Flooding of the backfill shall not be allowed.
- 3) Backfill operations around basement and/or reservoirs' walls shall not start before the completion and approval of the vertical waterproofing to wall of basement and before casting the reinforce concrete slab over basements.

3.07 Fill And Backfill Material For Structures (cont'd)

C) DENSITY

- 1) Backfill out side of building areas and under asphalt and other paving shall be thoroughly compacted by mechanical tamping to a minimum dry density of 95% of maximum density as determined by (ASTM D-1556).
- 2) Backfill under building slabs and slabs on grade shall be compacted to within 95% of maximum density and CBR>40 as determined by ASTM D1557, method D.

3.08 Fill And Backfill Of Utility Lines

The trenches shall not be backfilled until all the utilities' systems are installed and conform to the requirements specified in the sections covering the installation of the various utilities. Except as otherwise specified for special conditions of over depths, trenches shall be backfilled to the ground surface with selected excavated material or other material that is suitable for the specific compaction and as hereinafter specified. Trenches improperly backfilled shall be re-opened to the depth required for proper compaction, then refilled and compacted as specified.

A) Sand Cushion:

Beneath the pipe a 20 centimeter sand cushion will be provided to prevent point loading on the pipe due to any rock encountered.

B) Lower Portion Of Trench :

In pipe trenches, select backfill material, free from rocks and rock fragments, and deposit in trench simultaneously on both sides of pipe for full width of trench and to elevation of 30 centimeters above top of the barrel/ crown of pipe. Moisten, if necessary, tamp in thin (about 10 centimeters) layers and thoroughly compact under and on each side of pipe to provide solid backing against external surface of pipe. Walking or working on completed pipelines except as necessary in tamping or backfilling, is not permitted until trench has been backfilled at least 30 centimeters over top of pipe.

C) Remainder Of Trench:

The remainder of trench shall be backfilled with material that is free of stones larger than 15 centimeters in any dimension. backfill materials shall be deposited in layers not exceeding 10 centimeters in thickness, and each layer shall be compacted to an equivalent density to that of surrounding undisturbed soil.

3.9 Hardcore

- A. Where shown on the drawings provide a layer of hardcore under slab on grade to the thickness shown on drawings with a CBR>80.
- B. Hardcore shall be approved broken stone, well rammed and consolidated to the required thickness. The top surface of hardcore shall be blinded with sand to form an even surface to receive concrete or other finish.

3.10 Surplus Excavated Material

All surplus excavated material not used in backfilling or leveling shall be loaded and removed from the site and disposed-off at the Contractor's expense to a dump to be selected by the Contractor and approved by the Municipality or local authorities.

END OF SECTION

DIVISION 3
CONCRETE WORKS

Ref.	Description	Page No.		
03100	Concrete Formwork	03100-01	thru	03100-06
03200	Concrete Reinforcement	03200-01	thru	03200-04
03300	Cast-In-Place Concrete	03300-01	thru	03301-21
03370	Concrete Curing	03370-01	thru	03370-02

SECTION 03100

Concrete Formwork

PART 1 GENERAL

1.01 Work Included

- A. Pre-formed construction joints
- B. Dovetail anchor slots.
- C. External rear guards.
- D. Flashing reglets.
- E. Void Forms.
- F. Forming of expansion joints.
- G. Plain formwork.

1.02 Related Work

- A. Section 03200: Concrete Reinforcement.
- B. Section 03300: Cast-in-Place Concrete.
- C. Supports, Anchors and Seals for mechanical installations.
- D. Supporting Devices for electrical installations.

1.03 Quality Assurance

- A. Construct and erect concrete formwork in accordance with ACI 347, Jordanian General Specifications – 1996 and applicable construction safety regulations for place of Work.

1.04 Reference Standards

- A. ACI 347 - Recommended Practice For Concrete Formwork.

1.05 Shop Drawings

- A. Submit shop drawings in accordance with Section 01340.
- B. Indicate pertinent dimensioning, methods of construction, materials, arrangement of joints, ties and shores, location of bracing and temporary supports, schedule of erection and stripping.

PART 2 PRODUCTS

2.01 Wood Form Materials

- A. Plywood: Douglas Fir or Spruce species; sheathing grade; sound undamaged sheets with clean true edges.
- B. Lumber: spruce species; sheathing grade; with grade stamp clearly visible.
- C. Nails, Spikes, Lag Bolts, Through Bolts, and Anchorages: Sized as required; of sufficient strength and character to maintain formwork in place while pouring concrete.

2.02 Prefabricated Forms

- A. **Trough Forms:** Made of polypropylene or fibrous glass reinforced resin type, and shall be used where indicated on the drawings, and/or as instructed by the Supervising Engineer.

The forms, together with the supports, shall be of an approved manufacture, and must be approved by the Supervising Engineer as one complete system before proceeding with associated work.

The trough forms shall be well matched, tightly fit and adequately stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of the fair-faced finished concrete surfaces. The Forms must be accurately manufactured with due allowance made for thermal expansion and contraction in the spacing of the ribs, to a maximum tolerance of 5mm per rib module. The Trough forms employed for trough ribbed floor slabs shall provide 42cm deep ribs at 60cm spacing, and 7cm thick topping, all as shown and detailed on the relevant Structural Drawings. Dimensions may be slightly different from those shown provided max. Volume of concrete shall be (0.22) cubic meters per square meter.

2.02 Prefabricated Forms (cont'd)

The Supporting System shall be specifically designed to provide an adequate propping at precise multiples of the 600mm module. In addition it should be designed to allow removal of the forms while the slabs are kept propped until concrete has attained adequate strength; but generally no forms or supports shall be removed without the prior written approval of the Supervising Engineer.

- B. **Form Ties:** Removable or snap-off metal type of fixed or adjustable length; form ties should be free of defects and should not leave a hole larger than 25 mm in the concrete surface.
- C. **Form Release Agent:** Colorless mineral oil which will not stain concrete or impair natural bonding or color characteristic of coating intended for use on concrete.
- D. **Filletts for Chamfered Corners:** Rigid foam plastic type' of required size; maximum possible lengths.

2.05 Acceptable Manufacturers

- A. Acceptable Manufacturers:
 - 1. The Contractor shall submit to the Supervising Engineer the names of three manufacturers and their products which will be acceptable under this section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.06 Concrete Accessories

- A. **Flashing Reglets:** Minimum 0.6 mm thick galvanized steel longest possible lengths; complete with alignments splines for joints; securable to concrete formwork as approved by the Supervising Engineer; manufacturer subject to approval of the Supervising Engineer.
- B. Compressible filler in the form of permanent formwork, to be used as an expansion joint filler, and a cold applied sealant consisting of self-curing polysulphide rubber, manufactured by an approved manufacturer.

PART 3 EXECUTION

3.01 Formwork Erection

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.
- B. Construct formwork, shoring and bracing to meet design and code requirements, so that resultant finished concrete conforms to required shapes, lines and

dimensions.

- C. Arrange and assemble formwork to permit dismantling and stripping, so that concrete is not damaged during its removal.
- D. Align joints and make watertight, to prevent leakage of mortar and disfigure appearance of concrete. Keep form joints to minimum.
- E. Obtain the Supervising Engineer's review for use of earth forms. When using earth forms, hand-trim sides and bottoms, and remove loose dirt prior to placing concrete.
- F. Arrange forms to allow stripping without removal of principal shores, where and when these are required to remain in place.
- G. Obtain the Supervising Engineer's review before framing openings in structural members, which are not indicated on drawings.
- H. Provide bracing to ensure stability of formwork. Prop or strengthen previously constructed formwork liable to be over stressed by construction loads.
- I. Provide chamfer strips on external corners of members only where shown on drawings.
- J. Construct formwork to provide completed concrete surfaces complying with the tolerances specified in A.C.I. 347, after removal of forms and prior to patching and finishing of cast - in - place formed surfaces.
- K. Form expansion joints in the positions shown on the drawings and finish-off as follows :
 - Joint filled with a compressible filler in the form of permanent formwork.
 - Cold applied joint sealant consisting of self-curing approved polysulphide rubber.
- L. Apply form release agent on formwork in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices, and embedded items.
- M. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.
- N. Where trough forms are used, the finished concrete surface must be finished fair faced.

3.02 Inserts, Embedded Parts, And Openings

- A. Provide formed openings where required for pipes, conduits, sleeves, and other work to be embedded in and passing through concrete members.
- B. Locate and set in place items which will be cast directly into concrete.
- C. Coordinate work of other sections and cooperate with trade involved in forming

and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts. Do not perform work unless specifically indicated on drawings or reviewed prior to installation.

- D. Install concrete accessories in accordance with manufacturer's recommendations; straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain. Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be apparent in exposed concrete surfaces.

3.03 Field Quality Control

- A. Inspect and check completed formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and parts are secure.
- B. Inform the Supervising Engineer when formwork is complete and has been cleaned, to allow for inspection. Obtain review prior to placing concrete.
- C. Allow the Supervising Engineer to inspect each section of formwork prior to reuse.

3.05 Cleaning

- A. Clean forms as erection proceeds, to remove foreign matter. Remove cuttings, shavings, and debris from within forms. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-outs ports.
- B. During cold weather, remove ice from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.06 Form Removal

- A. Notify Supervising Engineer prior to removing formwork.
- B. Do not remove forms, shores and bracing until concrete has gained sufficient strength to carry its own weight, and construction and design load which are liable to be imposed upon it. Verify strength of concrete by compressive test results.
- C. Remove formwork progressively and in accordance with code requirements and so that no shock loads or unbalanced loads are imposed on structure.

- D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.
- E. Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by the Supervising Engineer.
- F. Store removed forms, for exposed architectural concrete, in manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
- G. Re-shore structural members where required due to design requirements or construction conditions and as required to permit progressive construction. Remove load supporting forms only when concrete has attained 75 percent of required 28 day compressive strength, provided construction is re-shored.
- H. Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.

END OF SECTION

SECTION 03200

Concrete Reinforcement

PART 1 GENERAL

1.01 Work Included

- A. Reinforcing steel bars, for cast-in-place concrete and welded steel wire fabric for semi mechanical fixed stone, complete with tie wire.
- B. Support chairs, bars supports, spacers, for reinforcing.

1.02 Related Work

- A. Section 03300: Cast-in-place concrete.

1.03 Quality Assurance

- A. Perform concrete reinforcing work in accordance with CRSI 63 and 65 unless specified otherwise in this section.

1.04 Source Quality Control

- A. Submit 3 certified copies of mill test report of supplied concrete reinforcing, indicating physical and chemical analysis for each site delivery.
- B. Provide the Supervising Engineer/Owner's Representative with access to fabrication plant to facilitate inspection of reinforcement. Notify of commencement and duration of shop fabrication, in sufficient time to allow for proper inspection.

1.05 Reference Standards

- A. BS 8110 - Code of practice for design and construction of structural concrete.
- B. CRSI 63 - Recommended Practice For Placing Reinforcing Bars.
- C. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.
- D. BS 4483 - Steel fabric for reinforcement of concrete
- E. BS4449 - Hot rolled steel bars for the reinforcement of concrete.
- F. Jordanian General Specifications – 1996

1.05 Reference Standards (cont'd)

- G. AWS D12.1 - Welding Reinforcement Steel, Metal Inserts Connections in Reinforced Concrete Construction.
- H. ACI 315 - American Concrete Institute - Manual of Standard

PART 2 PRODUCTS

2.01 Reinforcing

<u>Grade Minimum</u>	<u>Yield Strength</u>
High Yield Steel	414 N/mm ²
Mild Yield Steel	250 N/mm ²

- A. Reinforcing Steel: High yield deformed weldable steel bars, BS 4449 and BS 4461 ASTM A615.
- B. Welded Steel Wire Fabric: Deformed type A142, BS 4493; in flat sheets.

2.02 Quality Requirements

- A. Steel reinforcement shall be 250 N/mm² for mild yield steel and 412 N/mm² high yield steel complying with requirements of BS 4449, BS 4461 and BS 8110, deformed bars.
- B. Steel fabric mesh shall comply with BS 4483.

2.03 Fabrication

- A. Fabricate concrete reinforcing in accordance with ACI 315.
- B. Locate reinforcing splices, not indicated on drawings, at points of minimum stress. Location of splices: to be reviewed by the Supervising Engineer/Owner's Representative.

2.04 Accessory Materials

- A. Tie Wire: Minimum 1.5mm gauge annealed type, or patented system accepted by Supervising Engineer/Owner's Representative.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcing during construction conditions.
- C. Special Chairs, Bolsters, Bar Supports, Spacers where adjacent to architectural concrete surfaces: Plastic coated type; sized and shaped as required.

PART 3 EXECUTION

3.01 Placement And Fixing Of Reinforcement

- A. Place reinforcing supported and secured against displacement. Do not deviate from true alignment.
- B. Before placing concrete, ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings which would reduce bond to concrete.
- C. All reinforcement shall be fixed rigidly in position. At intersections the bars shall be bound together with tying wire and the loose ends of the wire shall be turned towards the inside of the member.
- D. Reinforcement shall only be spliced or welded where shown on the drawings. All welding procedures shall be subject to approval.
- E. Reinforcement shall be fixed in the positions shown on the drawings within a tolerance of 5mm or 5% of the lowest dimension of the cross-section of the member, whichever is greater .
- F. The concrete cover to the reinforcement shall be carefully maintained utilizing approved spacers where necessary. Unless indicated elsewhere in the contract documentation, the minimum concrete cover to all steel shall be in accordance with the drawings.
- G. Where concrete spacer blocks are used they shall not exceed 50mm square in section and shall be precast from concrete of similar mix proportions and strength as the adjacent concrete, except that the largest size of aggregate shall be 10mm.
- H. Spacer blocks shall not be used where the concrete face will be visible in the finished work, without the approval of the Supervising Engineer/Owner's Representative.
- I. Each concrete spacer block shall be securely fixed to the reinforcement with wire or a clip. The wire or clip shall be embedded in the center of the blocks so that it does not subsequently cause rust marks on the concrete surface.
- J. Supports and other subsidiary bars necessary to maintain the reinforcement in position shall be provided at approved intervals with concrete cover not less than that of the adjacent reinforcement.
- K. Fabric reinforcement shall be used in standard sheets where possible. Adjoining sheets shall overlap by at least one rectangle or 60 diameters of the bar at the lap, whichever is the greater.
- L. Scaffold boards shall be provided to ensure that the reinforcement is not displaced by being walked upon during concreting or other operations.

3.01 Placement And Fixing Of Reinforcement (cont'd)

- M. During concreting operations a competent steel fixer shall be in attendance to ensure that the reinforcement is maintained in the position as pouring and compaction proceeds.

3.02 Measurements and Rates

- A. Calculation of Steel reinforcement bars weight as shown below:

Diameter(mm) Weight(kg/m)

6	0.222
8	0.395
10	0.617
12	0.888
14	1.210
16	1.580
18	2.000
20	2.460
22	2.980
24	3.550
25	3.850
26	4.170
30	5.550
32	6.318

END OF SECTION

SECTION 03300

Cast-In-Place Concrete

PART 1 GENERAL

This section specifies work required for plain, reinforced and precast concrete.

1.01 Standards

All work shall be carried out in accordance with the following Reference Standards-

- A. The British Standard for structural use of concrete - BS 8110.
- B. The American Concrete Institute, A.C.I.
- C. The American Society for Testing Materials.
- D. The American Association of State Highway and Transportation Officials (AASHTO).

In case of discrepancy between this specification and the above reference standards, this specification shall take precedence.

1.02 Ordinary Structural Concrete

All plain, reinforced insitu, and precast concrete for general structural use is designed and must be constructed in accordance with BS - 8110.

1.03 Ready Mix Concrete

The Contractor shall submit the names of the proposed suppliers to the Supervising Engineer/Owner's Representative with their design mixes for each class of concrete used in this project as well as the sources of all materials to be incorporated in the mix. The Contractor shall also submit to the Supervising Engineer/Owner's Representative evidence of quality assurance management which the supplier adopts, for the Supervising Engineer/Owner's Representative review and approval prior to proceeding with the works.

The Contractor shall undertake and arrange for the Supervising Engineer/Owner's Representative to inspect the suppliers site concerning the Batch Plant and materials used by the Supplier and on regular intervals as and when directed by the Supervising Engineer/Owner's Representative.

The Contractor should provide all assistance and facilities including transportation to this regard.

1.04 Samples and Testing Of Materials

Prior to commencement of the concrete works, the Contractor shall submit samples of materials to the Supervising Engineer/Owner's Representative before sending them to nominated approved laboratories for testing, in order to establish the probability of the materials passing tests for the specified requirements.

Such samples shall be in sufficient amounts to enable test to be carried out and shall not be less than the quantities stated below

Cement	A mixed sample of equal quantities taken from at least one bag in every twenty, totaling 50 Kg for every batch of cement delivered to site.
Fine Aggregate & Sand for Mortar	0.03 m3 for each mix of concrete or for each size of aggregate.
Coarse Aggregate	0.03 m3.

Once the Supervising Engineer/Owner's Representative is satisfied that the samples with their sources are truly representative samples and sufficient quantities of these materials are readily available for the completion of all concrete works, then they shall be sent to the nominated approved laboratories for testing.

The Contractor shall have all laboratory tests made at his own expense.

During construction, all concrete, aggregate, cement and water shall be sampled and tested as frequently as deemed necessary by the Supervising Engineer/Owner's Representative. All test samples shall be supplied by the Contractor at his own expense. Samples shall be obtained in accordance with the latest revisions of the American Society of Testing Materials (ASTM) Designations C190, C184, C114, C227, C183, C265 and C109 or relevant British Standards (BS) Specifications.

PART 2 MATERIALS

2.01 Concrete Materials

a) Portland Cement

Unless otherwise stated, the cement shall be ordinary Portland Cement for all works (as described in the Bills of Quantities) originating from approved manufacturers, and shall comply with the requirements of and satisfy the tests contained in BS 12 for ordinary Portland Cement, the American Association of State Highway and Transportation Officials (AASHTO) Specification M-85 "Portland Cement" and/or ASTM Designation C150.

2.01 Concrete Materials (cont'd)

b) Bulk Deliveries

Cement delivered in bulk shall be accepted only if a central mixing plant is used.

c) Bags and Markings

The cement shall be delivered to the site in the original sealed bags of 50 Kg. net or other containers of the manufacturer in batches not exceeding 100 tons. The name and brand of manufacturer shall be plainly marked on bags or other containers, all bags or other containers shall be in good conditions at the time of inspection.

The Contractor shall present to the Supervising Engineer/Owner's Representative an official certificate of the manufacturer concerning the specifications and quality of the different types of cement.

d) Storage Of Cement

All cement shall be stored in suitable, weatherproof buildings which will protect the cement from dampness. Provisions for storage shall be ample, and the consignment of cement as received shall be separately stored in such a manner as to provide easy access for the identification and inspection of each consignment.

Stored cement shall meet the test requirements at any time after storage, should a retest be ordered by the Supervising Engineer/Owner's Representative. Cement shall be used in the order of delivery.

The Contractor shall keep accurate records of the deliveries of cement and of its use in the works. Copies of these records shall be supplied to the Supervising Engineer/Owner's Representative in such form as may be required.

e) Inspection

The Supervising Engineer/Owner's Representative shall be given every facility for sampling and inspection of the cement on and off the site.

The Contractor shall notify the Supervising Engineer/Owner's Representative of the dates of delivery so that there will be sufficient time for sampling the cement upon delivery.

f) Rejection

The cement shall be rejected if it fails to meet any of the requirements of these specifications

1. Packages varying by 5 percent or more from the specified weight shall be rejected and if the average weight of packages in any consignment, as shown by weighing 50 Kg. bags taken at random, is less than that specified, the entire consignment shall be rejected and the Contractor shall remove it and replace it with cement of satisfactory quality.

2.01 Concrete Materials (cont'd)

2. The provisional acceptance of the cement on site shall not deprive the Supervising Engineer/Owner's Representative of the right to reject or retest for soundness at any time.
3. No cement shall be used from any one batch until the result of the tests on that batch are known to be satisfactory. Any batch failing to pass the test shall be immediately removed from the site.

2.02 Aggregates Generally

a) General

The aggregate shall be selected and graded to produce a dense concrete free from voids and of good workability without requiring an excessive amount of water. Where necessary, and at no extra cost to the Owner the aggregates shall be washed and/or sieved until they comply with the requirements of BS 882 "Coarse and Fine Aggregate from Natural Sources for Concrete", and these specifications -

1. Gap-graded aggregates shall not be acceptable.
2. All aggregates shall consist of tough, hard, durable and uncoated particles. Approval of aggregate quality and/or gradation shall not waive the responsibility of the Contractor to produce concrete to the strength specified.

b) Care and Storage of Concrete Aggregates

Aggregates stock piles shall be built up and removed in layers not exceeding one meter in thickness on hard and clean surfaces with not more than 5 percent slope. The center of the storage area shall be elevated and slightly sloped to the sides in order to provide proper drainage of excess moisture.

Aggregate which has become segregated or contaminated with foreign matter during storage or handling will be rejected and shall be removed and replaced with material of acceptable quality at the Contractor's expense.

Aggregate shall be stored in sufficient quantity to ensure that shortage is not the cause of interruption of concreting works at any time.

2.03 Fine Aggregates

a) General

All fine aggregate for concrete shall conform to the AASHTO Specification M-6 "Fine Aggregate for Portland Cement Concrete", and/or BS 882 "Coarse and Fine Aggregate from Natural Sources for Concrete".

2.03 Fine Aggregates (cont'd)

Fine aggregate shall consist of natural sand having hard, strong, durable particles. It shall not contain harmful materials such as iron pyrites, coal, mica, shale, alkali, coated grains or similar laminated materials which may attack the reinforcement in such a way or in sufficient quantity to affect adversely the strength and durability of the concrete. The fine aggregate shall at no cost to the Owner be washed and sieved as required to remove deleterious substances.

Fine aggregate from different sources of supply shall not be mixed or stored in the same pile nor used alternately in the same class of construction mix.

b) Soundness

When the fine aggregate is subjected to five alternations of the sodium sulfate soundness test, the loss of weight shall not exceed 10 percent by weight.

c) Organic Impurities

All fine aggregate shall be free from injurious amounts of organic impurities and when subjected to the calorimetric test for organic impurities and producing a color darker than the standard, they shall be rejected unless they pass the mortar strength test.

Should the aggregate show a darker color than that of samples originally approved for the works, its use shall be withheld until tests satisfactory to the Supervising Engineer/Owner's Representative have been made to determine whether the increased color is indicative of an injurious amount of deleterious substances.

d) Grading

Fine aggregate shall be well and uniformly graded from coarse to fine, and shall be approved by the Supervising Engineer/Owner's Representative.

In particular, the maximum percentage by weight passing a No. 52 BS sieve or a No. 100 ASTM (0.1 mm.) sieve shall not exceed 5 percent of the total weight of fine aggregate.

Fine aggregate of the maximum percentage by weight passing a No. 100 British Standards sieve shall not exceed 10 percent.

2.04 Coarse Aggregates

a) General

All coarse aggregate for concrete shall conform to the AASHTO Specifications M-80 "Coarse Aggregate for Portland Cement Concrete" or BS Specifications 882 "Coarse and Fine Aggregate from Natural Sources for Concrete". Coarse aggregate shall consist of gravel, crushed gravel or crushed stone having hard, strong and durable pieces which are non-adherent. It shall not contain harmful materials such as iron pyrites, coal, mica, laminated materials or any materials which may attack the reinforcement in such a way or in sufficient quantity to affect adversely the strength and durability of the concrete. If necessary, coarse aggregate shall at no extra cost to the Owner be washed to remove deleterious substances.

b) Deleterious Substances

The total amount of deleterious substances shall not exceed 3 percent by weight of coarse aggregate.

c) Percentage Of Wear

Coarse aggregate shall conform to the following requirements -

Amount of wear, Los Angeles test

Not more than 35 percent over 500 revolutions at approximately 30 revolutions a minute.

d) Soundness

When a coarse aggregate is subjected to five alternations of the sodium soundness test, the loss by weight shall not exceed 10 percent.

Coarse aggregates failing to meet the requirements given in the previous paragraph may, at the option of the Supervising Engineer/Owner's Representative be subjected to an alternative freezing and thawing test.

The requirements for soundness given above may be waived by the Supervising Engineer/Owner's Representative, in the case of aggregate for use in structures or portion of structures not exposed to weathering.

e) Grading

Coarse aggregate shall be well and uniformly graded and shall be approved by the Supervising Engineer/Owner's Representative.

2.05 Light Weight Aggregates

a) General

All light weight aggregate for concrete shall conform to BS 3797 Part 2 "Light weight Aggregates for Concrete".

b) Grading

Light weight aggregate shall be well and uniformly graded and shall be approved by the Supervising Engineer/Owner's Representative.

Combined Aggregates

Approved fine and coarse aggregate in each batch of concrete shall be combined in proportion as approved by the Supervising Engineer/Owner's Representative according to test results giving the required compressive concrete stress as specified per type of concrete.

Special combined aggregate gradation shall be used for concrete members with reinforcement too close to permit proper gradation to another, this shall not be made during the progress of the works unless approved by the Supervising Engineer/Owner's Representative. Such changes will be admitted only after satisfactory test results.

2.06 Sand For Mortar

a) General

Sand used for mortar shall be from an approved source and shall pass a No. 7 B.S.S. Sieve with no more than 10 percent passing a No. 100 B.S.S Sieve and shall consist of hard, strong, durable uncoated mineral or rock particles, free from injurious amounts of organic or other deleterious substances.

b) Organic Impurities

Fine aggregate for mortar when subjected to the calorimetric test for organic impurities and producing a color darker than the standard color shall be rejected.

c) Grading

Sand for mortar shall be uniformly graded from fine to coarse and shall be approved by the Supervising Engineer/Owner's Representative.

2.07 Water

Water should comply with the requirements BS 5328.

2.08 Admixtures

a) General

- 1) Admixtures to concrete or mortar shall be used only when approved by the Client Representative and shall conform to the requirements to the AASHTO Specifications M-194 "Chemical Admixtures for Concrete" of ASTM Designation C949; Type D Water Reducing and Retarding Admixtures; or BS 5075, Part 1, 2 and 3 'Concrete Admixtures'.
- 2) Approved water reducing and retarding admixture from an approved manufacturer shall be used in the concrete of the raft foundation.
- 3) The admixtures shall be stored in such a manner as to permit easy access for proper inspection and identification for each shipment and in a suitable weather-tight building that will protect the admixtures from dampness.
- 4) Admixture for concrete work shall be liquid form, super plasticizer. Costs of such admixtures, sampling and testing shall be borne by the Contractor.

b) Tests

The Sub Contractor shall ensure that the admixture supplied for use in the work must be the same as the admixture subjected to test under this Specification. Test on admixtures shall be made whenever practicable, using the cement, aggregates and water proposed for the specific work because the effects produced by chemical admixtures may vary with the properties of the other ingredients of the concrete.

c) Types Of Admixtures

Water reducing and retarding admixtures shall be approved in writing by the Client Representative before use.

Where concrete is required to be waterproofed, the Sub Contractor shall use approved admixtures subject to the requirements of the Specifications.

Admixtures that contain relatively large amounts of chloride accelerating corrosion of reinforcing steel shall not be used without the approval of the Client Representative.

- D) Chloride ion content in admixtures is not to exceed 2% by weight of admixture or 0.03% by weight of cement in mix.
- E) Total chloride content in concrete mix arising from constituents and other sources is not to exceed the following percentage of chloride ion to cement by weight -
 - concrete made with sulphate resisting cement 0.15%
 - Concrete containing embedded metal and made with ordinary Portland cement 0.30% for 95% of test results with no results greater than 0.50%
- F) Total sulphate content in concrete mix arising from constituents and other sources is not to exceed the lesser of 0.4% by weight of aggregates or 3.7% by weight of cement in mix

2.09 Acceptable Suppliers

1. The Contractor shall submit to the Supervising Engineer/Owner's Representative the names of three sub-contractors/suppliers and their products which will be acceptable under this section. Approval of the sub-contractor/supplier or product must be obtained before proceedings with associated work.

2.10 Accessories

- A. Non-shrink Grout premixed compound consisting of non- metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 17 MPa in 2 days and 48 MPa in 28 days.

2.11 Concrete Mixes

- A. Mix concrete in accordance with BS 5328.

Concrete mixing shall be made in conformity to the requirements outlined in the foregoing sections for concrete material, on the other sections pertaining to controlling temperature, and on the mixes properties outlined in the following table. The concrete production shall also comply with the recommendations of the Jordanian specifications.

- B. The following table gives general guidelines on the constituents of different mixes to be produced

Trial mixes to be made by the Contractor to establish mix design for all the concrete types.

Concrete Grade	Minimum Cement Content kg/m ³	Maximum Size Of Aggregate S(mm)	Maximum Free Water Cement Ratio	Characteristic Cube Strength Mpa		Slump (mm)
				at 7day	at 28days	
30	300	20	0.60	20	30	90-130
15	200	20	0.70	10	15	100-150

Note: When using admixtures SLUMP will vary and will be determined as per the trial mix design

- C) Three (3) concrete standard test cubes will be taken for every 50 or less cubic meters of concrete placed.
- D) Three (3) additional standard test cubes will be taken during either hot or cold weather concreting, and be cured under same conditions as the concrete it represents.
- E) One (1) slump test will be taken for each set of test cubes taken and for each batch.
- F) The Contractor shall use for the composition of the concrete three different uniform ranges of aggregates, one for fine aggregates and two for coarse aggregates. The Contractor shall obtain the approval of the Supervising Engineer/Owner's Representative in determining the extreme limits of each aggregate range based on laboratory results of the trial mixes, presented by the Contractor and specified in the clause "Proportions of Constituents of Concrete".

2.12 Proportions Of Constituents Of Concrete

a) General

In general the least amount of fine aggregate which will ensure concrete of the required workability for the placing conditions involved should be used. Any change in weight of fine aggregate made by the Contractor for the purposes of adjusting workability must be compensated for by a corresponding change in weight of coarse aggregate in the opposite direction. After the materials provided by the Contractor have been accepted for the works, the proportions and equivalent batch weight shall be determined which will produce concrete having not less than the strength required.

All adjustments in the proportions of the constituents of the concrete shall be approved by the Supervising Engineer/Owner's Representative before use in the works.

b) Trial Mixes

The actual proportions shall be determined on the basis of trial mixes made by the Contractor and conducted with the content being determined by means of yield test in accordance with AASHTO Specifications T-121 or ASTM Designation C138.

Immediately upon award of Contract, the Contractor shall make trial mixes in adequate number of specimens as per the relevant standards and in accordance with the description set forth in the General Specifications.

From the results of tests made on the Specimens, Contractor shall propose the mix design of each of the concrete grades listed in the tabulation referred to in sub article 3.13 -a-.

The proportions will be such as to obtain (within a tolerance of plus or minus 1 percent) the cement content shown in the table of composition of concrete. However, if the materials supplied by the Contractor are of such a nature or are so graded that proportions based on the minimum cement content cannot be used without exceeding the maximum allowable water content specified in the table, then the proportions will be adjusted so as to require the least amount of cement which will produce concrete at the suitable plasticity and workability content. No compensation will be made for the increased quantity of cement required.

c) Designation Of Mixes

The mixes required will be designated and recorded in (a) kilograms of fine and coarse aggregates excluding free water, per 50 Kg of cement and in (b) liters of total mixing water per 50 Kg of cement related to the amount of cement required per cubic meter of concrete. These proportions shall not be changed during the progress of the work except as provided for below.

2.12 Proportions Of Constituents Of Concrete (cont'd)

d) Batch Weights

Since the proportions are designated in terms of aggregate in surface dry conditions, the equivalent batch weights to be used in the works shall be corrected periodically to take into account the actual moisture content of the aggregates at the time of use.

e) Adjustment During The Progress Of The Works

No adjustment shall be permitted which results in concrete of a lesser compressive strength than those specified under "Composition of Concrete" for each grade of concrete.

After the original proportions have been designated, as prescribed above, these proportions shall not be changed during the progress of the work except as follows -

I. Adjustment For Variation In Workability

If it is found impossible to obtain concrete of a suitable plasticity and workability with the proportions originally designated, the Contractor may change the specified proportions. Such changes shall be based on actual test results, provided that in no case shall the amount of cement originally designated be decreased.

II. Adjustment For Variation In Yield

If the cement content of the concrete, determined by means of yield tests in AASHTO Specifications T-121 or ASTM Designation C138, varies more than 1 percent from the designated value, the proportions shall be adjusted so as to bring the cement to within 1 percent of designated value.

III. Adjustment For Minimum Strength

If it is found impossible to produce concrete, having the minimum allowable compressive strength as specified, the cement content shall be increased as directed by the Supervising Engineer/Owner's Representative.

IV. Adjustment For Change Of Materials

No change in the source or properties of the materials shall be made without due notice to the Supervising Engineer/Owner's Representative and no new materials shall be used until the Supervising Engineer/Owner's Representative has accepted them and new proportions based on test trials have been determined.

2.12 Proportions Of Constituents Of Concrete (cont'd)

Should any of the above mentioned changes require an increase in the minimum quantity of cement specified, no additional compensation will be made to the Contractor.

2.13 Measurements Of Materials

a) General

All measuring devices shall be subject to approval by the Supervising Engineer/Owner's Representative.

Materials shall be measured by weighing, except as otherwise specified or where other methods are specifically authorized by the Supervising Engineer/Owner's Representative. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Each size of aggregate and the cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities can be measured to within 1 percent of the desired amount. Cement in standard bags need not be weighed.

B) Measurement Of Water

The mixing water shall be measured by volume or by weight. The water measuring device shall be susceptible to control accuracy of plus or minus half percent of the capacity of the tank.

C) Volumetric Measurements

Where volumetric measurements are exceptionally authorized by the Supervising Engineer/Owner's Representative, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture conditions of the aggregate, including the bulking effect in the fine aggregate.

2.14 Mixing Of Concrete

a) General

Concrete shall generally be machine mixed.

All materials shall be accurately measured in accordance with the terms of 'Measurement of Materials'.

The mixing of concrete or mortar shall not be permitted when the temperature is above 40 °C or less than 2°C.

2.14 Mixing Of Concrete (cont'd)

b) Equipment

All mixing machines, wheel barrows, vessels, platforms, tools and other equipment used for mixing, transportation or placing concrete shall be kept clean at all times. All shall be thoroughly cleaned before using a different type of cement. Mixing machines which have been out of use for more than twenty minutes shall be thoroughly cleaned out before any fresh concrete is mixed in them.

c) Hand Mixing

In certain cases, i.e. small works or for mortar, mixing by hand will be determined on application to the Supervising Engineer/Owner's Representative. In this event the aggregates shall be spread on a clean and dry concrete, metal or boarded surface and the cement spread over. The whole of the materials being added through a rose to ensure that the materials cling together. In all cases where hand mixing is permitted the amount of cement shall be increased by 10 percent at the Contractor's own expense.

d) Mixing At Site

Should the Contractor use mixing at site (for minor structural items) then the Contractor shall at his own cost provide a rented site adjacent to the project site for erecting his Batch Mixer, and for storing all materials to be incorporated in the Project work.

Concrete shall be thoroughly mixed in a batch mixer of an approved size and type which will ensure a uniform distribution of the materials throughout the mass.

The mixer shall be equipped with adequate water storage and device for accurately measuring and automatically controlling the amount of water used in each batch. Mechanical means shall be provided for recording the number of revolutions for each batch and automatically preventing the discharge of the mixer until the materials have been mixed for the specified number of revolutions and/or minimum time.

All concrete shall be mixed for a period of not less than 75 seconds after all materials have been introduced to the mixer and discharged as prescribed in AASHTO Specifications T-126. During the period of mixing, the mixer shall operate at a speed of not less than 14 and not more than 20 revolutions per minute.

The first batch of materials for concrete placed in the mixer shall contain a sufficient excess of cement, sand and water to coat the inside of the drum to avoid reducing the required content of these materials for subsequent mixes. Upon cessation of mixing for an appropriate period, the mixer shall be thoroughly cleaned.

2.14 Mixing Of Concrete (cont'd)

e) Truck Mixing

Truck mixers shall be of the revolving drum type, water tight and so constructed that the concrete can be mixed to ensure a uniform distribution of materials throughout the mass. Materials for the concrete shall be charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a tank for carrying mixing water.

Only the prescribed amount of water shall be placed in the tank unless the tank is equipped with a device by which the quantity of water added to the batch can be readily verified. Truck mixers shall be provided with means by which the mixing time can be readily verified by the Supervising Engineer/Owner's Representative.

Mixing shall begin within 30 minutes after the cement has been added to the aggregate. When cement is charged into a mixer drum containing surface-wet aggregate and when the temperature is above 33 degrees C, this limit shall be reduced to 15 minutes. The limitation or time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when in the judgment of the Supervising Engineer/Owner's Representative the aggregates are sufficiently free from moisture.

f) Partial Mixing at the Central Plant

When a truck mixer is used for transportation, the mixing time at the mixing plant may be reduced to 30 seconds and the mixing completed in the truck mixer. The mixing time in the truck mixer shall be as specified under "d" 'Mixing at Site' above.

When truck mixers are used, water must only be added when trucks reach the construction site.

g) Plant Mix

Mixing at a central plant shall conform to the requirements for "Mixing at Site" and to the AASHTO Specifications M-157.

h) Time Of Hauling and Placing Concrete

Concrete transported in a truck mixer shall be discharged at the job and placed in its final position in the forms within 30 minutes after water is first added to the mix.

2.14 Mixing Of Concrete (cont'd)

i) Delivery

The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 minutes and the methods of delivering and handling the concrete shall be such as to allow placing without re-handling and without damage to the structure or the concrete.

j) Re-tempering

The concrete shall be mixed only in such quantities as are required for immediate use and any concrete which has developed initial set shall not be used. Concrete which has partially hardened shall not be re-tempered or remixed.

PART 3 EXECUTION

3.01 Handling & Placing Of Concrete

a) General

1. Concreting shall be discontinued when the temperature is less than 4 degrees C. and more than 40 degrees C. Conform to ACI 305 and ACI 306 when concreting in hot and cold weather respectively.

3.01 Handling & Placing Of Concrete (cont'd)

1. Place concrete in accordance with BS 8110.
2. Notify the Supervising Engineer/Owner's Representative minimum 24 hours prior to commencement of concreting operations.
3. Ensure anchors, seats, plates, and other items to be cast into concrete are placed, held securely, and will not cause hardship in placing concrete. Rectify same and proceed with work.
4. Coordinate with the Electro-Mechanical Contractor the positioning and installation of all sleeves, inserts and other items to be cast into concrete are installed prior to closing the formwork and/or casting of the concrete.
5. Maintain records of poured concrete items, in an approved form, details of every pour of concrete placed in the permanent works including
 - Class of concrete.
 - Location and date of pour.
 - Ambient temperature and concrete temperature at time of placing.
 - Moisture content of aggregates.
 - Details of mixes, batch numbers and cement batch number.
 - Results of tests.
 - Location of test cube sample point.

6. Weekly records Provide four copies of records each week covering work carried preceding week.
7. Monthly records provide monthly histograms of all 28 day cube strength and both monthly and accumulative standard deviations and other information which the Supervising Engineer/Owner's Representative may require concerning concrete placed in the permanent works.
8. Transport concrete to avoid contamination, segregation or loss of ingredients.
9. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
10. Prepare previously placed concrete by cleaning to the Supervising Engineer/Owner's Representative's satisfaction as detailed under sub-clause 3.17-h.
11. Pour concrete continuously between predetermined construction and control joints.
12. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Supervising Engineer/Owner's Representative upon discovery.
13. Maintain concrete cover around reinforcing as noted on structural drawings.
 - a. Special precautions shall be taken during concreting in temperatures greater than 32 degree C. in respect of the cooling of aggregates, maintenance of the correct water/cement ratios and the proper carrying out of the work. The approval of the Supervising Engineer/Owner's Representative shall be obtained for concreting above these conditions.
 - b. Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only upon the authorization in writing of the Supervising Engineer/Owner's Representative. If inferior quality of concrete is produced by the use of such conveyors, the Supervising Engineer/Owner's Representative may order discontinuance of their use and the substitution of a satisfactory method of placing.
 - c. In the case of small sections of concrete, the Supervising Engineer/Owner's Representative may at his discretion order the Contractor to consolidate the concrete by means of hand punning instead of vibration.
14. Casting bays allow not less than 48 hours between casting of adjacent bays separated by construction joints or formed contraction joints.
15. Expansion Joints do not place concrete on both sides of joint at same time unless otherwise approved.

3.01 Handling & Placing Of Concrete (cont'd)

b) Concreting In Cold Weather

- 1- Aggregates, water, formwork and reinforcement must always be free from ice, snow or frost for the production and placing of concrete.
- 2- The Contractor shall keep on site an accurate minimum-maximum thermometer suitably positioned to represent the environment in which concrete is being placed and shall keep daily records of the minimum and maximum temperatures.
- 3- No concrete shall be placed when the air temperature is less 3 degrees C. on a falling thermometer or 6 degrees C. on a rising thermometer without the permission of the Supervising Engineer/Owner's Representative.
- 4- In the event of the Supervising Engineer/Owner's Representative giving such permission, the following shall apply-
 - Concreting shall be at the sole risk of the Contractor and shall be carried out during the day only.
 - The Contractor shall take the precautions described in BS 8110 Section 6.7 including the making of test cubes cured under the same conditions as the concrete.
 - Any concrete damaged by frost shall be removed.

c) Preparation Of Formwork

In preparation for the placing of concrete, all sawdust, chips and other construction debris and extraneous matter shall be removed from the interior of forms, struts, stays and braces serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete shall be removed when the concrete placing has reached a level rendering their service unnecessary.

These temporary members shall be entirely removed from the forms and not buried in the concrete.

d) Chutes, Troughs and Pipes

Open troughs and chutes shall be of metal or metal lined. Where steep slopes are required, the chutes shall not be less than one vertical to two horizontal units.

All chutes, troughs and pipes shall be kept clean and free from coatings or hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure.

3.01 Handling & Placing Of Concrete (cont'd)

e) Depositing

When placing operations would involve dropping the concrete more than 1.5 m., it shall be deposited through sheet metal or other approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After the initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcement bars which project.

f) Compacting

Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions.

- 1- The vibration shall be internal unless special authorization of other methods is given by the Supervising Engineer/Owner's Representative or as provided herein.
- 2- Vibrators shall be of a type and design approved by the Supervising Engineer/Owner's Representative. They shall be capable of transmitting vibrations to the concrete at frequencies of not less than 4500 impulses per minute.
- 3- The intensity of vibration shall be such as to visibly affect a mass of concrete of 2.5 cm. slump over a radius of at least 45 cm.
- 4- The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms.
- 5- Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms.
- 6- Vibrators shall be applied at the point of deposit and in the areas of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation, vibration shall not be continued at any one point to the extent that localized areas of grout are formed.
- 7- Application of vibrators shall be at points uniformly spaced and not further apart than twice the radius over which the vibrator visibly affects the concrete.
- 8- Vibrations shall not be applied directly or through the reinforcement to sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation and vibrators shall not be used to transport concrete in the forms.

3.01 Handling & Placing Of Concrete (cont'd)

- 9- Vibrators shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.
- 10- The use of implements such as compressors which are likely to disturb or disarrange reinforcement shall not be permitted.

g) Concrete Layers

Concrete shall be placed in horizontal layers not more than 30 cm. thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead.

Each layer shall be placed and compacted before the preceding batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the batches. Each layer shall be compacted so as to avoid the formation of a construction joint with the preceding layer which has not taken initial set.

h) Discontinuance Of Concrete

When placing of concrete is temporarily discontinued, the concrete after becoming firm enough to retain its form shall be cleaned of laitance and other objectionable materials to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces the top surface of the concrete adjacent to the forms shall be smoothed with a trowel.

Immediately following an approved discontinuation of placing concrete, all accumulations or mortar splashed upon the reinforcement bars and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete steel bond at and near the surface of the concrete while cleaning the reinforcement bars.

3.02 Construction Joints

Keyed Construction joints shall be made only where located on the approved shop drawings. In the case of emergency, construction joints shall be placed as directed by the Supervising Engineer/Owner's Representative. Shear keys or inclined reinforcement shall be used where necessary to transmit shear or bond the two sections together, pending the Supervising Engineer/Owner's Representative approval.

Before depositing new concrete on or against concrete which has hardened, the form shall be retightened. The surface of the hardened concrete shall be roughened as required by the Supervising Engineer/Owner's Representative in a manner that will not leave loosened particles of aggregate or damaged concrete at the surface.

3.02 Construction Joints (cont'd)

It shall be thoroughly cleaned of foreign matter and laitance and saturated with water. To ensure an excess of mortar at the juncture of the hardened and the newly deposited concrete, the cleaned and saturated surfaces, including vertical and inclined surfaces shall first be thoroughly covered with a coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints which are exposed to view shall be carefully finished to line and elevation.

3.03 Construction Joints In Reinforced Concrete Walls

Reinforced concrete walls shall be poured in sections not exceeding 15 meters in length. The height being from slab to slab.

3.04 Blinding Concrete

Thickness shall be as shown on the drawings. Blinding concrete shall be used under all structural slabs, beams and reinforced concrete footings.

3.05 Conform To ACI 305 When Concreting During Hot Weather.

3.06 Conform To ACI 306 When Concreting During Cold Weather.

3.07 Separate Floor Toppings

- A. Place concrete floor toppings to required lines and levels.
- B. Prior to placing remove deleterious material. Broom and vacuum clean. Place required dividers edge strips reinforcing and other items to be cast in.

3.08 Screeding

- A. Screed floors slabs-on-fill and concrete base for toppings level, maintaining surface flatness of maximum 2 mm/m.

The design mix must first be tested and approved by the Supervising Engineer/Owner's Representative prior to commencement of the actual screeding work.

The concrete surface to be screeded shall be thoroughly cleaned to the Supervising Engineer/Owner's Representative 's satisfaction, and then primed with an approved bonding coat.

Lay screed to a true flat surface and finish off trowelled smooth.

3.08 Screeding (cont'd)

- B. Light weight foam concrete screed to roof with dry density of 450 kg/cu.m and 1.4 Mpa compressive strength in accordance with ASTM C869, average thickness as indicated on the drawings with 20mm cement/sand (1:4) topping with a minimum thickness of 30mm at the drains and a minimum slope of 0.75%.

3.09 Patching

- A. Allow the Engineer to inspect concrete surfaces immediately upon removal of forms. Patch imperfections as directed.

3.10 Defective Concrete

- A. Modify or replace concrete not conforming to required lines, details and elevations.
- B. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Do not patch, fill, touch-up, repair, or replace exposed architectural concrete except upon express direction of the Supervising Engineer/Owner's Representative for each individual area.

3.11 Concrete Finishing

- A. Provide concrete surfaces to be left exposed as directed and in accordance with BS 8110.

3.12 Curing and Protection

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

END OF SECTION

SECTION 03370

Concrete Curing

PART 1 GENERAL

1.01 Work Included

- A. Initial and final curing.
- B. Curing materials.

1.02 Related Work

- A. Section 03300: Cast-in-Place Concrete.
- B. Section 03100: Formwork.

1.03 References

- A. ANSI A168.1 Practice for Curing Concrete
- B. ACI 305 Recommended Practice for Hot Weather Concreting
- C. ACI 306 Recommended Practice for Cold Weather Curing
- D. ACI 308 - 71 Recommended Practice for Curing Concrete

PART 2 PRODUCTS

2.01 Materials

- A. Water: Potable
- B. Absorptive Mats Burlap: cloth made of jute or kenaf conforming to AASHTO M182 and minimum weight 0.29 Kg/m².
- C. Membrane Curing Compound: acrylic, or chlorinated rubber type, pigmented.
- D. Polyethylene Film: 0.1 mm thick, clear color.

PART 3 EXECUTION

3.01 Curing water should be of a temperature compatible with concrete temperature and not more than 11 degree C cooler concrete surface.

3.02 Ponding

A. Maintain 100% coverage of water over slabs continuously for 5 days.

3.03 Spraying

A. Spray water over slabs and maintain wet for 5 days.

3.04 Absorptive Mat

A. Saturate burlap and place over exposed areas, lapping ends and sides minimum 50% over lap, and maintain in place saturated for 5 days.

3.05 Membrane Curing Compound

A. Apply curing compound in strict accordance with manufacturer's instructions.

END OF SECTION

DIVISION 4
MASONRY WORKS

Ref.	Description	Page No.		
04100	Mortar	04100-01	thru	04100-03
04450	Natural Stone Work	04550-01	thru	04550-09

SECTION 04100

Mortar

PART 1 GENERAL

1.01 Work Included

- A. Mortar for stone.

1.02 Related Work

- A. Section 04450 – Natural Stone Work

1.03 Quality Assurance

- A. Perform work in accordance with requirements of BS 4551.

1.04 Reference Standards

- A. BS 12 - Ordinary Portland Cement.
- B. BS 890 - Building limes.
- C. BS 882 - Aggregates from natural sources for concrete.
- D. BS 4551 - Methods of testing mortars.
- E. BS 4721 - Specification for ready-mixed building mortars.

1.05 Testing

- A. Testing of mortar mix(es) will be performed by a firm appointed and paid for by the Contractor.
- B. Provide free access to all portions of work and cooperate with appointed firm.
- C. Submit proposed mortar mix design to testing firm for approval prior to commencement of work.

1.05 Testing (cont'd)

- D. Tests of mortar mix(es) will be performed to ensure conformance with requirements stated herein and to ensure mortar will not produce efflorescence.
- E. If mortar mix(es) do not conform with requirements stated herein, re-establish and re-submit for further testing. Pay costs for required retesting.

1.06 Submittals

- A. Submit manufacturer's recommendations and product data in accordance with Section 01340.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

- A. The Contractor shall submit to the Supervising Engineer\Owner's Representative the names of three manufacturers and their products which will be acceptable under this section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.02 Mortar Materials

- A. Portland Cement: BS12 Ordinary Portland Cement; grey color, refer to Section 03300 - Clause 2.01, Item "A".
- B. Aggregates: standard masonry type, BS 882, clean, dry and protected against dampness, freezing and foreign matter, refer to Section 03300 - Clause 2.02, 2.03, 2.04 and 2.05.
- C. Water: clean and free from injurious amounts of oil, alkali, organic matter or other deleterious material.

2.03 Admixtures

- A. Plasticizer: water reducing type which reduces porosity and absorption to increase bond strength; as approved by the Supervising Engineer/Owner's Representative refer to Section 03300 - Clause 2.08.

2.04 Mortar Mix

- A. Provide minimum 15 MPa mortar for non-load bearing walls and partitions.

PART 3 EXECUTION

3.01 Mixing Mortar

- A. Thoroughly mix mortar ingredients, in quantities needed for immediate use.
- B. Add mortar color and admixtures in accordance with manufacturer's recommendations. Ensure uniformity of mix and coloration.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. Use mortar within two hours of mixing at temperatures over (26 deg. C), and two and one half hours at temperatures under 10 degrees C.
- E. If necessary, retemper mortar within two hours of mixing to replace water lost by evaporation. Do not retemper mortar after two hours of mixing.

END OF SECTION

SECTION 04450

Natural Stone Work

PART 1 GENERAL

1.01 Work Included

- A. Natural Stone cladding, Jerusalem Stone, 50mm thick.
- B. Natural Stone coping, lintels and sills.

1.02 References

- A. ASTM A36 - Structural Steel.
- B. Jordan General Specifications - 1996

1.03 Submittals

- A. GENERAL:

Refer to Conditions of Contract, Shop Drawings, Product Data and Samples, for submittals provisions and procedures.

- B. SHOP DRAWINGS AND PRODUCT DATA:

- 1- Submit shop drawings and product data in accordance with conditions of contract. Shop drawings shall clearly indicate expansion joints dimensions and locations.
- 2- Indicate pertinent dimensioning, layout, anchorages, construction details, method of installation and adjacent construction.
- 3- Indicate all units of stone, i.e. sills, lintels, copings, etc. and their configuration and size; materials and types of anchorage items and their locations.
- 4- Submit stone field erection drawings.
- 5- Submit manufacturer's instructions for use of pointing colour and admixtures.

1.03 Submittals (cont'd)

C. SAMPLES:

- 1- Submit two sets of each type of stone, full size units as selected by the Supervising Engineer/Owner's Representative /Owner's Representative to the project site, in sufficient number to indicate the full range of color, texture and each type of finish. One of each of the duplicate samples approved by the Supervising Engineer/Owner's Representative /Owner's Representative will be retained by him at the project site, the other being returned to the stone supplier for his guidance. Colours and types of stone-dressings are as mentioned under Part 2 - Products, paragraph B, "Stone Schedule".
- 2- The following physical data on all proposed stone shall be submitted by the Supplier:
 - a) Analysis of mineral composition.
 - b) Analysis of chemical composition.
 - c) Thermal sufficient of expansion.
 - d) Absorption
 - e) Specific Gravity.
 - f) Modulus of Rupture
 - g) Abrasion Resistance.
- 3- Submit samples of other materials specified herein upon request by the Supervising Engineer/Owner's Representative /Owner's Representative .

1.04 Guarantee/Warranty

- A. Attention is directed to the provisions of the CONDITIONS OF THE CONTRACT regarding guarantees/warranties for the Work.
- B. All warranties/guarantees to be issued by the Supplier, Manufacturers and sub-contractors shall be counter-signed by Trade Contractor and both of them will be liable for repair/replace the items/works, etc., during the warrantee/guarantee period.

1.05 Standards

- A. Applicable provisions of the following standard publications shall apply throughout the work:
 1. Ministry of Public Works. The General Technical Specifications for buildings, section 5, volume 1, STONWORK; "Recommended Practices for the use of Natural Stones in Building constructions".

1.06 References

- A. National standards referenced herein are included to establish recognized quality only. Equivalent quality and testing standards will be acceptable subject to their timely submission, review and acceptance by the Supervising Engineer/Owner's Representative .

1.07 Qualifications

- A. Supplier/Fabricator: A firm having an adequate supply of the specified type of stone and an annual rated production capacity to deliver the stone to the project site on schedule within a time limit established by the Supervising Engineer/Owner's Representative , as required, to assure no delay in the progress and completion of the Work.
- B. Installer: A qualified stone layer with a minimum of five years successful experience in the erection of stone work.

1.08 Delivery, Storage & Handling

- A. **PACKING AND LOADING:**
Finished stone shall be carefully packed and loaded for shipment using all reasonable and customary precautions against damage in transit. No material which may cause staining or discolouration shall be used for blocking or packing.
- B. **SITE STORAGE:**

Upon receipt at the building site or storage yard, the stone shall be stocked on timber or platforms at least 100mm above the ground, and extreme care shall be taken to prevent staining during storage. If storage is to be for a prolonged period, polyethylene or other suitable plastic film shall be placed between any wood and finished surfaces, and shall be used also as an overall protective covering. Salt shall not be used for melting of ice formed on pieces, or for any purpose involving its contact with the stone.
- C. **DEFECTIVE STONE:**

Any piece of stone showing flaws, cracks, or imperfections such as vents, sand and clay holes, shelly bars, shakes, mottle, seams or starts upon receipt at the storage yard, or at the building site, shall be discarded and removed from the work site, and at the contractor's own expense.

1.9 Environmental Requirements

- A. The following environmental requirements are applicable to stone set in mortar.
 - 1. During freezing or near freezing weather provide equipment and cover to maintain a minimum of 4 degrees C and to protect stone work completed or in progress.
 - 2. At end of working day, or during rainy weather, cover stone work exposed to weather with waterproof coverings, securely anchored.
 - 3. Maintain materials and surrounding air to a minimum 10 degrees C prior to, during and 48 hours after completion of work.

PART 2 PRODUCTS

2.01 Stone Materials and Fabrication

- A. General
 - 1. Stone shall be of good quality, sound, free from cracks and defects, seams or starts which may impair its structural integrity, durability, appearance or function. Colour, texture and finish shall be within the range of samples approved by the Supervising Engineer/Owner's Representative .
 - 2. All stone shall be obtained from quarries having adequate capacity and facility to meet the specified requirements. Cutting and finishing shall be performed by using approved equipment to process the material promptly on order and in strict accordance with the specifications. Evidence to this effect shall be provided by the contractor's.
 - 3. Stone rejected for noncompliance with the submitted samples or the requirements of this Specification shall be replaced with material acceptable to the Supervising Engineer/Owner's Representative. Replacement shall be prompt and at the Contractor's own expense. Inspection of stone by the Supervising Engineer/Owner's Representative shall not relieve the Contractor of his responsibilities to perform all work in accordance with the Contract Documents.

B. STONE PROPERTIES.

Property	Type A	Type B	Type C	Method of Testing
Specific Gravity (Minimum)	2.56	2.45	2.16	ASTM-C97
Water Absorption (%) (Minimum)	3.00	4.20	7.50	ASTM-C97
Modules of Rupture (Minimum)	6.90	5.20	3.40	ASTM-C99
Abrasion Resistance (Minimum)	10.00	10.00	10.00	ASTM-C241
Compressive Strength (Minimum)	55.00	28.00	12.00	ASTM-C170
External Properties:	All stone samples shall be of good quality, sound, free from cracks and defects, seams or starts which may impair its structural properties. Samples should be consistent in color and texture.			

C. STONE FABRICATION:

1. Fabrication of stone shall be in strict accordance with approved shop drawings for fabrication, and with this specification.
2. To the maximum extent possible, fabrication and assembly of stone shall be executed in the shop. Work that is not shop assembled shall be shop fitted.
3. All work shall be of the highest quality, in accordance with the best trade practices, and performed by skilled workmen. All materials and workmanship shall conform to the highest industry standards, including the BSI Recommended Practices for the Use of Natural Stone in Building Construction.
4. Use no materials, equipment, or practices that may adversely affect the functioning, appearance, or durability of the stone work or work of other trades.

D. DIMENSIONS:

1. Cut all stone work accurately to shape and dimensions shown on the final approved shop drawings. Exposed plane surfaces shall be true. Bed and joint surfaces shall be dressed straight and at right angles to the faces, unless otherwise shown. Exposed arris lines shall be sharp and true. Patching of stone will not be permitted.

E. BEDS AND JOINTS:

Stone beds and joints surfaces shall be cut square from the face for the entire thickness of stones. Stone shall be bedded and jointed including the various expansion joints dimensions as shown on the approved shop drawings.

2.01 Stone Materials and Fabrication (Cont'd)

F. EXTERIOR SPECIAL SHAPES:

All specially shaped pieces of stones shall be constant in profile throughout their length, in strict conformity with details shown on approved shop drawings.

2.02 Mortar Materials and Accessories

A. CEMENT:-

1. Cement for Setting Mortar: Non-staining Portland Cement conforming to ASTM C150, Type I, except containing not more than 0.03% water soluble alkali.
2. Cement for Pointing Mortar: Non-staining white Portland Cement conforming to ASTM C150. Grey nonstaining cement may be used for pointing mortar colour of pointing mortar, as selected by the Supervising Engineer/Owner's Representative , does not require White Portland Cement.

B. WATER:-

Water shall be potable, clean and fresh from public water system.

C. SAND:-

Well graded non-staining masonry sand conforming to ASTM C144. Use white Silica sand for pointing mortar. No other sand shall be permitted for mortar or grout unless otherwise tested and approved by the Supervising Engineer/Owner's Representative .

D. LIME:-

Approved brand of plastic hydrated, such as New England 4X, conforming to ASTM C207, Type "S".

E. Wall Ties: Formed steel wire, 3 mm diameter, hot-dip galvanized to A153/A153M.

F. Plugs: Formed steel wire, 5 mm diameter, hot-dip galvanized to A153/A153M.

G. Clips: 80x30x2 mm hot-dip galvanized to A153/A153M fixed with 2 power driven nails.

H. Cleaning Solution: Non-acid, not harmful to stone, joint materials, or adjacent surfaces.

PART 3 - EXECUTION

3.01 Conditions At Site

- A. The Contractor shall, prior to proceeding with the stone installation, examine all surfaces and parts of the structure to receive stone work, and notify the Supervising Engineer/Owner's Representative in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with installation until such conditions have been corrected and are acceptable to the Supervising Engineer/Owner's Representative.
- B. Verify all measurements and dimensions, coordinate the installation of inserts for this work and coordinate and schedule this work with the work of other trades. Give particular attention to the location and size of cutouts required to accommodate mechanical, electrical, and other work or adjoining construction, in accordance with the reviewed shop drawings for such trade.

3.02 Stone Installation

A. PREPARATION FOR STONE INSTALLATION:

Clean stone prior to setting, leaving edges and surfaces free from dirt and foreign material. Do not use wire brushes or implements which mark or damage exposed surfaces, unless otherwise approved by the Supervising Engineer/Owner's Representative .

C. MORTAR AND GROUT PROPORTIONING - BY VOLUME:-

1. General: Mortar and Grout proportioning shall be prepared and tested by the Contractor, all in accordance with Section 04100, and in addition the Contractor shall allow for preparing and testing the mortar and grout mixes included within this section to meet the Supervising Engineer/Owner's Representative 's satisfaction and approval.
2. Setting Mortar for Stone:
 - a) Portland Cement - 1 part
 - b) Hydrated Lime - 0-0.25 part
 - c) Sand - 3 parts
 - d) Plasticier
 - e) Integral waterproofer
3. Pointing Mortar:
 - a) White Portland Cement - 1 part
 - b) Sand - 1-1/2 parts
 - c) Add color additive to acquire the color of mortar approved by the Supervising Engineer/Owner's Representative.
 - d) Add water proofer

3.02 Stone Installation (cont'd)

4. NOTE: Add integral waterproofing admixture to setting and pointing mortar in the quantity and manner recommended by the manufacturer.

Mortar plasticiser shall be used in all mortars, unless otherwise instructed by the Supervising Engineer/Owner's Representative .

5. Wall Grout

1. Fine grout shall be mixed in the following proportions by volume all in accordance with ASTM C476:
 - a) Portland Cement - 1 part
 - b) Hydrated Lime - 0.1 part
 - c) Sand - 2.25-3 parts
2. Coarse grout, where required, shall be mixed in the following proportions by volume, all in accordance with ASTM C476:
 - a) Portland Cement - 1 part
 - b) Hydrated Lime - 0.1 part
 - c) Fine Aggregate - 2.25 parts
 - d) Coarse Aggregate - 1-2 parts

Use sufficient water to produce a fluid, pourable consistency.

D. MORTAR AND GROUT MIXING:-

- 1- Mortar and grout shall be machine mixed. Cement and hydrated lime may be batched by the bag. Sand preferably shall be batched by weight, but subject to the approval of the Supervising Engineer/Owner's Representative may on certain small operations be batched by volume in suitably calibrated containers, provided proper allowance is made for weight per cubic foot, contained moisture, bulking and consolidation. Shovel measurement shall not be used.
- 2- Workability or consistency of mortar on the board shall be sufficiently wet to be worked under the trowel. Water for tempering shall be available on the scaffold at all times. Mortar and grout which has begun to "set" shall be discarded. Mortar and grout which has stiffened due to evaporation shall be retempered to restore its workability. Retempering of mortar and grout at the mixer shall not be permitted.

E. Reinforcement and Anchorage:

1. Install cold rolled steel mesh 6 mm diameter at 150 mm both directions.
2. Lap joint reinforcement ends minimum 150 mm.

3.02 Stone Installation (cont'd)

3. Attach wall ties to steel mesh back to bond veneer stone to back-up at maximum 250 mm oc vertically and at the two ends of each stone piece horizontally, 5mm diameter, 40 mm long galvanized steel plugs shall be used.
4. 80x30x2 mm galvanized steel clips fixed to walls using two power driven nails at 750 mm spaces shall be used to fix the steel mesh.

3.03 Protection

- A. Stone shall at all times be protected from drippings, welding spatter and damage by other trades during construction. Where necessary or directed, substantial non-staining wooden or other approved covering shall be placed to protect the work. Heavy polyethylene film shall be used between stone and wood. Maintain all protection until removed to permit final cleaning of stone work.

3.04 Cleaning

- A. Clean soiled surfaces using non-acidic solution of type which will not harm stone, mortar joint materials, or adjacent surfaces.
- B. Use non-metallic tools in cleaning operations.

3.05 Final Inspection:

- A. Finished surfaces shall show no objectionable visual distinction in jointing, bedding, plane, colour, texture, pattern, and finish. All stones which in the opinion of the Supervising Engineer/Owner's Representative do not provide the required uniformity shall be relocated, or removed and replaced with new stone units to the satisfaction of the Supervising Engineer/Owner's Representative and at the Contractor's own expense.
- C. All defective stone shall be replaced with new stone units, except that minor damages may be repaired when approved by the Supervising Engineer/Owner's Representative. Repairs, when approved, shall be completed to the satisfaction of the Supervising Engineer/Owner's Representative. When the repairs to stone are unsatisfactory to the Supervising Engineer/Owner's Representative, the stone shall be replaced with new stone. All repairs and all replacements of defective and unsatisfactorily repaired stone shall be performed at the Contractor's own expense.

END OF SECTION

DIVISION 5
METAL WORKS

Ref.	Description	Page No.		
05500	Miscellaneous Metal Fabrications	05500-01	thru	05500-07
05520	Handrails And Railings	05520-01	thru	05520-04

SECTION 05500

Miscellaneous Metal Fabrications

PART 1 GENERAL

1.01 Work Included

- A. Metal fabrications include items made from stainless steel, aluminium and/or cast iron and steel shapes, plates, bars, and strips which are not a part of structural steel or other metal systems specified elsewhere.
- B. Types of work, in this section include metal fabrications for the following, some of which are detailed on the structural and/or architectural drawings:
 - 1) Powder coated steel grill
 - 2) Powder coated steel stair
 - 3) Powder coated steel gate

1.02 Quality Assurances:

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for timing and fitting where taking field measurements before fabrication might delay work.
- B. Shop Assembly: Pre-assemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for re-assembly and co-ordinated installation.

1.03 References

A. Applicable Publications The following publications of the issues listed below, but referred to thereafter by basic designation only form a part of this Section

1. Federal Specifications, Naval Publications and Forms Centre, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120, USA

FF-W-92B Washers, Flat (Plain).

RR-G-661E Grating, Metal, Bar Type (Floor, Except for Naval Vessels).

2. American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10018, USA

A14.3-1984 Fixed Ladders, Safety Requirements for.

3. American Society for Testing and Materials (ASTM) Standards, 1916 Race Street, Philadelphia, Pennsylvania 19103, USA

A27-83 Specifications for Steel Castings, Carbon, for General Application.

A36-81a Specification for Structural Steel.

A47-77 Specification for Malleable Iron Castings.

A53-82 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

A123-78 Specification of Zinc (Hot-Galvanised) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.

A153-82 Specification of Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

A307-83a Specification for Carbon Steel Externally Threaded Standard Fasteners.

A386-78 Specification for Zinc Coating (Hot-Dip) on assembled Steel Products.

A569-72(1979) Specification of Steel, Carbon (0.15 Maximum, Percent), Hot Rolled Sheet and Strip, Commercial Quality.

F593-82 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

1.03 References (cont'd)

4. American Welding Society, Inc., (AWS), 2501 N.W. 7th Street, Miami, Florida 33125, USA

D1.1-85 Structural Welding Code - Steel.

5. Military Specifications, Naval Publications and Forms Centre, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120, USA.

MIL-P-21035A Paint, High Zinc Content, Galvanising Repair (Metric).

6. National Association of Architectural Metal Manufacturers (NAAMM), 221N. La Salle, Chicago, Illinois 60601, USA

Metal Bar Grating Manual - October 1979

7. Steel Structures Painting Council (SSPC) ; 440Fifth Avenue, Pittsburgh, Pennsylvania 15213, USA

PA1 Shop, Field & Maintenance Painting, November 1, 1982.
Paint 20 Zinc-Rich Primers (Type I - Inorganic and Type II - organic),
November 1, 1982.
SP3 Power Tool Cleaning, November 1, 1982.

1.04 Submittals

- A. Product Data Submit Manufacturer's specifications, anchor details and installation instructions for products used in miscellaneous metal fabrications, including paint products.
- B. Shop Drawings Submit shop drawings for fabrication and erection of miscellaneous metal fabrications. Include plan, elevations and details of sections and connections, Show anchorage and accessory items. Provide templates for anchor and bolt installation in critical area.
 1. Where materials or fabrications are indicated to comply with certain requirement for design loading, include structural computations, material properties and other information needed for structural analysis.

1.04 Submittals (cont'd)

C. Samples submit the following samples

- 1) Fasteners Threaded; standard fasteners; or wedged type.
- 2) Bolts, nuts and washers Regular Hexagon head type washers, round, carbon steel.
- 3) Welding Materials AWS D1.1; type required for materials being welded.

PART 2 PRODUCTS

2.01 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 including pitting, seam marks, roller marks, rolled trade names and roughness.
- 2) Steel Plates, Shapes and Bars ASTM A36.
- 3) Stainless Steel Bolts, Hex Cap Screws and Studs ASTM F593.
- 4) Steel pipe ASTM a53; type and grade and as required for design loading; black finish; standards weight (Schedule 20), unless otherwise indicated.
- 5) Brackets, flanges and Anchors Cast or Formed metal of the same type material and finish as supported rails, unless otherwise indicated.
- 6) Concrete Inserts Threaded or wedge type; galvanised ferrous castings, either malleable iron, ASTM A47, or cast steel, ASTM A27. provide bolts, washers and shims as required , hot -dip galvanised, ASTM A153.

B. Fasteners

- 1) Bolts and Nuts Regular hexagon head type, ASTM A307, Grade A.
- 2) Plain Washers Round, Carbon Steel, Federal Specification FF-W092.

2.01 Materials (cont'd)

- C. Paint: As shown on drawings and as per the Supervising Engineer/Owner's Representative instructions and as follows:
- 1) Shop Primer for Ferrous Metal Manufacturer's or fabricator's standard, fast-curing, lead-free primer; selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated and for capability of obtaining a sound foundation for field-applied topcoats despite prolonged exposure.
 - 2) Galvanising Repair Paint High zinc dust content paint for re galvanising welds in galvanised steel, complying with the Military Specification MIL-P-21035 (Ships) or SSPC-Paint 20.
 - 3) Provide RAL polyester powder coating where indicated colour as per Engineer's selection

2.02 Fabrication, General

A. Workmanship

- 1) Use materials of size and thickness indicated or, if not indicated, as required to produce strength and durability in finished product for use intended. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support. Use type of materials shown or specified for various components of work.
- 2) Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1 mm (1/32 inch), unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- 3) Weld corners and seams continuously, complying with AWS recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces. Welding to or on structural steel shall be in accordance with the Structural Welding Code of the American Welding Society.
- 4) Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flat-head (counter sunk) screws or bolts.
- 5) Prepare for anchorage of type indicated, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.
- 2) Cut, reinforce, drill and tap miscellaneous metal work as indicated to receive finish hardware and similar items.

2.02 Fabrication, General (cont'd)

- 3) Galvanising Furnish a zinc coating for those items shown or specified to be galvanised, as follows:
 - a. ASTM A153 for galvanising iron and steel hardware.
 - b. ASTM A123 for galvanising rolled, pressed and forged steel shapes, plates, bars and strip 3mm (1/8-ich) thick and heavier.
 - c. ASTM A386 for galvanising assembled steel products.
- B. Shop Painting Apply shop primer to surfaces of metal fabrications except those which are galvanised, stainless steel or as indicated to be embedded in concrete or masonry, unless other wise indicated, and in compliance with requirements of SSPC-PA1 "Paint Application Specification No. 1" for shop painting.
- C. Surface Preparation Prepare ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications
 - 1) Interiors (SSPC Zone 1A) SSPC-SP3 "Power Tool Cleaning"

PART 3 EXECUTION

3.01 Preparation

- A. Field Measurements take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.
- B. Co-ordinate 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 construction. Co-ordinate delivery of such items to project site.

3.02 Installation

- A. General
 - 1) Fastening to In-Place Construction Install anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for connectors as required.
 - 2) Cutting, Fitting and Placement
 - a. Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Use temporary bracing or anchors in

formwork for items which are to be built into concrete, masonry or similar construction.

3.02 Installation (cont'd)

- b. 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.
- 3) Field welding Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

3.03 Adjust And Clean

- A. 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 .05 mm (2.0 mils).
- B. For Galvanised Surfaces Clean field welds, bolted connections and abraded areas and apply two coats of galvanising repair paint.

END OF SECTION

SECTION 05520

Handrails and Railing

PART 1 GENERAL

1.01 Section Includes

- A. Stainless steel mesh cladding on steel tubes floor mounted railing and fittings; complete with all requisite accessories.

1.02 References

- A. ASTM A53 - Hot-Dipped, Zinc-coated Welded and Seamless Steel Pipe.
- B. ASTM A123 - Zinc (Hot-Dip Galvanised) Coatings on Iron and Steel Products.
- C. ASTM A500 - Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- D. ASTM A501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- E. ASTM B211 - Aluminum-Alloy Bars, Rods, and Wire.
- F. ASTM B221 - Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
- G. ASTM B241 - Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
- H. ASTM B483 - Aluminum and Aluminum-Alloy Drawn Tubes For General Purpose Applications.
- I. ASTM E935 - Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
- J. ASTM E985 - Permanent Metal Railing Systems and Rails for Buildings.
- K. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.
- L. BS 3100: 1991 and BS1449: Part 2: 1983 for stainless steel sections.

1.03 Design Requirements

- A. Railing assembly, steps rails, and attachments to resist lateral force of 35 Kg. at any point without damage or permanent set. Test in accordance with ASTM A935.

1.04 Submittals For Review

- A. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- B. Samples: Submit long samples of handrail. Submit samples, of elbow, Tee, wall bracket, escutcheon and end stop.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

The Contractor shall submit to the Supervising Engineer\Owner's Representative the names of three manufacturers and their products which will be acceptable under this section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.02 Stainless Steel Railings And Handrails

- A. Fabricate steel railings, posts and handrails to design, dimensions, and details indicated. Furnish railings and handrail members formed of the size indicated.
- B. Fabrication : Jointing of post, rail, and corners shall be by one of the following methods :
 - 1) Flush-type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 10mm (3/8 inch) hexagonal-recessed-head set screws.
 - 2) Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight-fitting interior sleeve not less than 152 mm (6 inches) long.
 - 3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and that the pipe is not crushed.

2.02 Stainless Steel Railings And Handrails (cont'd)

- 4) Furnish removable railing where indicated.
- 5) Railings and handrails shall be capable of withstanding a concentrated load of 91 Kg. (200 pounds) applied at any point in any direction.

2.03 Fabrication

- A. Fit and shop assemble components in largest practical sizes for delivery to site.
- B. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- C. Provide anchors, plates and angles, etc.; as required for connecting railings to structure.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
- G. Interior Components: Continuously seal joined pieces by continuous welds.
- H. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- I. Accurately form components, to each other and to building structure.
- J. Accommodate for expansion and contraction of members and building movement without damage to connections or members.

PART 3 EXECUTION

3.01 Examination

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 Preparation

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete and/or embedded in masonry with setting templates, to appropriate sections.

3.03 Installation

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects.
- C. Anchor railings to structure with anchors, plates, angles, etc. as approved by the Supervising Engineer/Owner's Representative.
- D. Field weld anchors as indicated on approved shop drawings. Touch-up welds with primer. Grind welds smooth.
- E. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 Erection Tolerances

- A. Maximum Variation From Plumb: 3 mm per storey, non-cumulative.
- B. Maximum Offset From True Alignment: 3 mm.
- C. Maximum Out-of-Position: 3 mm.

3.05 Schedule

- A. Refer to the Drawings and Book of Details for Detail Nos. and locations.
- B. Steel pipe railings, powder coated finish.

END OF SECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

Ref.	Description	Page No.		
07120	Fluid Applied Water Proofing	07120-01	thru	07120-03
07535	Modified Bitumen Roofing Membrane	07535-01	thru	07535-09
07600	Sheet Metal Flashing and Trim	07600-01	thru	07600-03
07900	Sealants	07900-01	thru	07900-03

SECTION 07120

Fluid Applied Waterproofing

PART 1 GENERAL

1.01 Work Included

- A. Clean and prepare surfaces to receive waterproofing.
- B. Fluid applied waterproofing.

1.02 Related Work

- A. Mechanical items projecting through waterproofing.

1.03 Reference Standards

- A. ASTM C355 Water Vapor Transmission of Thick materials.
- B. ASTM D412 Rubber Properties in Tension.
- C. ASTM D624 Rubber Property - Tear Resistance.
- D. ASTM D2240 Rubber Property - Durometer Hardness
- E. Jordanian specifications for Structural and Architectural Works (1996)

1.04 Product Data

- A. Submit Product data in accordance with Section 01340.
- B. Submit manufacturer's recommendations for surface conditioner compatibility, elastic flashing, joint cover sheet and joint and crack sealants along with temperature range for application of waterproofing membrane for review by the Supervising Engineer\Owner's Representative .

1.05 Environmental Requirements

- A. Do not apply waterproofing material during inclement weather or when air temperature is below 40 degrees F (5 degrees C).
- B. Do not apply waterproofing material to damp, frozen, dirty, dusty, or unsuitable deck surfaces. Concrete surfaces must be cured for 28 days.
- C. Provide positive ventilation when waterproofing material is applied in enclosed areas, to remove toxic fumes.

1.06 Warranty

- A. Provide written warranties in the name of the Owner.
- B. Warranty shall provide for making good, within period of five (5) years, at no cost to Owner, failures of waterproofing to resist penetration of water, except where such failures are result of structural failures of building. Hairline cracking due to temperature or shrinkage is not considered as structural failure. Repair and make good waterproofing membrane and pay for and repair or replace all affected or damaged materials or surfaces at no cost to Owner.

1.07 Inspection And Testing

- A. Inspection and, when necessary, testing will be performed by a firm appointed in accordance with Section 01400. Provide free unobstructed access to all portions of work and cooperate with appointed firm.
- B. Perform inspection of waterproofing to ensure conformance with requirements. If defects are revealed, the Supervising Engineer\Owner's Representative may request that waterproof material be subject to tests to ascertain full extent of defects. Pay for costs of required testing and inspection.
- C. Correct defects and irregularities as advised by the Manufacturer . Pay for costs incurred including additional inspection and testing of corrected work.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

- A. The Contractor shall submit to the Supervising Engineer\Owner's Representative the names of three manufacturers and their products which will be acceptable under this Section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.02 Materials

- A. Water Proofing material: Two component elastomeric compound; cold applied; quick setting.
- B. Two layers 3mm thick hot applied bitumen

PART 3 EXECUTION

3.01 Inspection Of Surfaces And Cleaning

- A. Ensure that drains, sleeves and curbs which pass through surfaces to receive waterproofing are properly and rigidly installed.
- B. Ensure surfaces are free of cracks, depressions, waves or projections which may be detrimental to proper installation of waterproofing membrane. Repair surfaces as required.
- C. Seal cracks and expansion joints with recommended backup material and sealant. Ensure proper depth-width ratio as recommended by sealant manufacturer.
- D. Clean surfaces of dust, dirt and other foreign matter detrimental to proper installation of waterproofing membrane.

3.02 Preparation

- A. Apply surface conditioner at a rate not exceeding 1 liter per 10 square meters nor less than 1 liter per 5 square meters depending on concrete surface. Protect surface conditioner from rain or frost until dry.

3.03 Application

- A. Apply waterproofing material in accordance with manufacturer's recommendations.
- B. Continue material up vertical surfaces to a minimum of 150 mm unless otherwise noted.
- C. Seal items projecting through waterproofing.

END OF SECTION

SECTION 07535

Modified Bitumen Roofing Membrane

PART 1 GENERAL

1.01 Work Included

- A. Cleaning substrate, preparing and applying light weight concrete including forming rain water drains and outlets; application of primer coat.
- B. Modified bitumen sheet roofing, installation.
- C. Counter flashing and sealing sheet at termination.
- D. Sealants.

1.02 Related Work

- A. Section 07900 - Sealants.
- B. Section 03300 - Light weight concrete roof screeds.

1.03 Reference Standards

- A. Materials shall have the characteristics specified by current international regulations or failing these shall meet the conditions specified by current standards in countries of origin. Acceptable Standards of reference are as follows:
 - 1. UEATC (European Union for Technical Agreement in Construction).
 - General Directives for the Assessment of Roof Waterproofing Systems MOAT 27, January 83.
 - Special Directives for the Assessment of SBS Elastomer bitumen MOAT31, August 84.
 - UE Atc, c/o BBA, P.O. Box 195, Bucknalls Lane, Watford, WD2 7NG, U.K.
 - 2. ASTM (American Society for Testing Materials) ASTM C869, ASTM 1227D type 4.

1.03 Reference Standards (cont'd)

3. CSTB (Scientific and Technical Center for Construction) 4 Av. du Recteur Poincare 75016 Paris.
 - DTU 20-12- Code of Practice- Concrete roofs to receive waterproofing.
 - DTU 43-1 - Code of Practice - Roofing over concrete deck
 - FIT Classification for roof waterproofing - Sept. 89.
4. DIN (Deutsche Institute Fur Normung) Unter den Eichen 87 D 1000 Berlin 45 Germany.
 - Sealing and Insulating Roofing materials testing and design Standards.

1.04 Shop Drawings And Product Data:

A. *Submittals* :

1. *Shop Drawings*

Indicated layout of sheets including side and end laps, mechanical equipment, counter flashing, drains and penetrations details.

2. *Product Data* :

Submit manufacturer's printed specification and installation instructions, including procedures and materials for terminations, penetrations, flashings compatibility and bonding. The Contractor shall provide with his submittals all the relevant Standards documentation.

3. *Samples* :

Membranes	: Three 115mm x 75mm samples
Flashing Membrane	: Three 115mm x 78mm samples
Insulation	: Three 600mm x 600mm samples
Metal Flashing	: Three 300mm sample in the required color
Primer	: 1 Liter

Accepted samples will be retained to serve as a basis for checking at the time of delivery of materials to site. The manufacturer shall furnish, when requested, proof of origin and quality of the materials that will be used or where it has been applied.. Only materials specified or approved by the Supervising Engineer\Owner's Representative will be permitted to be used. The Supervising Engineer\Owner's Representative will stipulate acceptance tests and their mode of operation to be carried out on materials supplied by the contractor. The Contractor will carry out these tests in his own laboratory under the control of the Supervising Engineer\Owner's Representative, Rejected materials will be immediately isolated and labeled to avoid any risk of confusion. They will be removed from the site by the Contractor within 48 hours following their rejection.

1.04 Shop Drawings And Product Data: (cont'd)

B) *Contractor Certification*

The Contractor is required to : -

Submit manufacturer's certification standing materials ordered and supplied are compatible with each other, suited for locations and purpose intended and shipped in sufficient quantity to ensure proper timely installation.

Submit manufacturer's approval of applicator.

Submit a certificate signed by the manufacturer for the materials specified which states materials installed on the project manufacturer's published performance standards and the requirements.

Submit Complete details about the contractor's company : company's profile, list of specialized staff with their respective qualification and experience in Jordan. climatic conditions, references (minimum 5 years), evidence of their ability to handle projects of a similar volume and list of equipment.

C. *Manufacturer Approval*

- 1) For uniformity of the efficiency and future maintenance, all the products proposed for waterproofing shall be from the same manufacturer or approved by the waterproofing membrane Manufacturer. Furthermore, a guarantee of 10 years availability of the approved materials shall be submitted by the manufacturer.
- 2) The manufacturer shall have an in house quality control set up complying with UEATC directives and/or with latest version of ISO series standards : manufacturer quality control manual shall be available for the Supervising Engineer\Owner's Representative checking at time of submission.
- 3) The manufacturer in house quality control shall be periodically audited by an independent technical control office for compliance with the Q.C. manual and standard recommendations. Certificates from the technical control office shall be available for The Supervising Engineer\Owner's Representative checking.

1.05 Warranty

- A. Provide warranty in the name of the Owner for materials and workmanship of water proofing. This warranty shall clearly include the following:
1. All materials in the waterproofing systems shall be free from manufacturing defects and comply with manufacturer's published technical specifications.
 2. All workmanship in waterproofing systems shall be free from any defects and comply with all respect to the manufacturer's technical instructions and control.
 3. This warranty becomes operative from the date of issue of the preliminary handing over certificate of the contract and shall be valid for a period of ten (10) calendar years.
 - * Within this warranty the Contractor is liable for the cost of :
 - * Repair of defected materials or installation of replacement materials or system.
 - * Damages to the building and/or the building contents due to such materials.
 - * Financial loss and/or physical injury due to such materials.

The text of the warranty shall be to the Supervising Engineer\Owner's Representative approval.

PART 2 PRODUCTS

2.01 Materials

A. ***Basic Materials:***

Waterproofing Membranes: The membranes to be used shall comply with the specification as detailed below, Test reports shall be made available to the Supervising Engineer\Owner's Representative upon request:-

Softening Point	>130 °C(ASTM D36)
Penetration at 25 C	20 -40 (ASTM D5)
Cold Flexibility	-20 °C
Tensile Strength	(L)900 N/5; cm
Dimensional Stability	<0.2%
Elongation At Break	50%
Static Puncture Resistance	>25Kg
Dynamic Puncture Resistance	>20 Joules
Tearing Resistance	270 N

2.01 Materials (cont'd)

B) *Miscellaneous Materials*

- 1) **Primer:** The primer to be used shall comply with all respect to ASTM D 41 and shall be applied at a minimum rate of 0.250-0.300 kg/Sq.m. As recommended by the manufacturer and approved by the Supervising Engineer\Owner's Representative.
- 2) **Corner reinforcing strip:** A 3mm thick SBS elastomeric bitumen membrane finished on both sides with a macro perforated torch-off film allowing laying by torch or hot bitumen, glass-grid reinforced for a tensile strength of at least 900 N/5 cm. The bitumen compound shall have the same characteristics than the main waterproofing membrane.
- 3) **Metal Flashing:** 1.5mm minimum thick anodized aluminum, color at the Consultant request.
- 4) **Mastic Sealant:** Polysulphide, silicone or polyurethane rubber sealant.
- 5) **Drain Water Outlets:** They shall consist of a prefabricated flange and a welded pipe, flange dimension exceeding 120mm from edge of pipe opening. Pipe shall be of a diameter and a length adapted to the roof condition. Outlets can be metal made (lead, zinc, copper or similar approved) or bitumen-compatible rubber such as EPDM. All flanges shall be primed on both faces before insertion in the waterproofing built-up, Bottom of the pipe shall be sealed to the down pipe entry.

2.02 Acceptable Manufacturers

A. Approved Manufactures

- a. LAMA Jordan,
- b. Dremapit, Saudi Arabia
- c. Pitumode, Egypt

or approved equal

- B. Approval of the manufacturer or product must be obtained before proceeding with associated work.

PART 3 EXECUTION

3.01 Inspection

After proper cleaning of the roof area, a complete level survey shall be carried out by the Contractor, including identification of hollow or debonded areas by tapping with a steel rod (these areas will produce a hollow sound). The extent of debonding must be clearly marked. Slope and planeity survey shall be carried out with the following tolerances :

1) *Slope:*

- * Minimum slope requirement : 0.75%
- * Water ponding area shall be identified clearly.

2) *Planeity:*

- * Tolerances for planeity shall be :
 - 5mm with a 2 meters straight edge.
 - 3mm with a 200mm straight edge.

3) *Surface :*

The surface shall be smooth, clean, dry and free of dust, grease, oil, foreign chemicals curing compound. Complete survey report shall be submitted to the Supervising Engineer\Owner's Representative.

4) *Details :*

- * All details shall be finalized before waterproofing works to start :
- * Rainwater drains shall be well located, inn sufficient number and ready to receive waterproofing membranes.
- * Expansion joints shall be located at highest roof points, on reinforced concrete curbs chamfered as shown on drawings.
- * All pipes, cables and other penetrations shall be in place. Provision for proper waterproofing at Chillers and Machinery shall be made.
- * All parapets shall be in place, with provision for groove or counter flashing at and acceptable height (150mm above finished roof level).

3.02 Preparatory Work

- A. Before commencing installation of the roof waterproofing and insulation system all construction work and installations above roof level shall be completed as far as possible. Particular care shall be taken to ensure:
 - 1. All rainwater, plumbing, air-conditioning and ventilation duct outlets have been fixed in position and are protected against blockage or accidental damage.
 - 2. Supports to ductwork, pipework, cable tray and the like have been installed.
 - 3. All curbs to roof lights, access doors, plant and water tanks have been installed.
 - 4. All chases for Skirtings, etc., have been prepared.
- B. The surface of the substrate shall be clean and dry, free from ridges or indentations, laid to fall as required and not contaminated with oil or other deleterious matter.
- C. No waterproof membrane shall be applied until the substrate has been inspected and approved by the Supervising Engineer/Owner's Representative.
- D. The Contractor shall abide by all means to National and International Labor and health regulations. Safety precautions on Site shall incorporate, but are not limited to :
 - 1) All ladders and temporary stairs to be well secured at top and bottom.
 - 2) Sufficient number of fire extinguishers to be available.
 - 3) Safety helmet for every worker.
 - 4) All materials shall be stored in dry area, out of direct sunlight and according to manufacturer's instructions (correct rolls position, maximum load and stacking allowed,..)
 - 5) It is not permitted to store material on the building in such concentrations as to impose excessive stress and strain on deck or structural members.
 - 6) In the event that any materials for use in this section deteriorate and become unusable due to inadequate and poor storage they shall be removed from site as instructed by the Consultant / Department and replaced at the contractor's expense.

3.03 Installation

- A. Install materials in accordance with instructions officially issued by the Manufacturer. Manufacturer's technical representative shall be present as necessary to ensure proper installation.
- B. Modified bitumen torchable membrane, 4mm thick to roofs reinforced with 180gm/m² non-woven polyester fabric with 50gm/m² non woven glass fiber, fully bonded to substrate.
- D. Install sheet roofing in accordance with the manufacturer's instructions, and the following requirements : -.
 - 1- The waterproofing membrane shall be fully bonded with a rich hot bitumen coating.
 - 2- The flame welding process shall not be used unless specifically ordered by the Supervising Engineer\Owner's Representative as complementary to the full and proper execution of the works, at the contractor's own expense.
- E. Work out air bubbles, wrinkles, and fishmouths. Roll sheet into place, without stretching.
- F. Seal ends and edges to each other and to adjoining surfaces with uniform fillet bead of sealant.
- G. Seal watertight items projecting through membrane with counter flashing membrane material.
- H. Adjacent rolls of waterproofing membrane should be provided with a minimum 150mm lap and complete adhesion must be achieved between both layers to ensure complete waterproofing.
- I. All external and internal angles and corners shall be reinforced with an extra strip of waterproofing membrane minimum 300mm wide.
- J. Where waterproofing membrane is to be terminated at a certain height of the wall, the waterproofing membrane should be turned and dressed into the recess formed in the concrete wall and sealed off with an approved sealing compound.
- K. Pipes and other projections through waterproofing membrane should be properly treated with reinforcing strips, collars etc. as per ,manufacturer's recommendations to ensure complete waterproofing.
- L. Where waterproof membrane is to be left exposed for any length of time the top edge should be batter fixed to secure edge. The perimeter should be left and an extended edge of layer continuity , and the free edge be adequately protected while exposed.
- M. Before laying the protective covers, inspect to ensure no damage. Any damaged areas should be cleaned and patched in accordance with manufacturer's recommendations to ensure complete waterproofing.

3.04 Testing

- A) Flood test 72 hours minimum after completion of the waterproofing works.
- B) Restrict water run-off from membrane area by plugging drains and creating dams or dikes. Flood restricted area to depth of about 100mm and maintain at this depth for 48 hours.
- C) Repair any leaks which develop and retest
- D) At completion of flood test, drain plugs will be removed.
- E) Water supply will be given main contractor from the existing network at no cost to the Contractor, the later being responsible for the necessary equipment and labor.

END OF SECTION

SECTION 07600

Flashing and Sheet Metal

PART 1 GENERAL

1.01 Work Included

- A. Top of dressed in recess waterproofing aluminum flashings.
- B. Brushed stainless steel metal flashing for parapet top.

1.02 Related Work

- A. Section 07900: Sealants.

1.03 Reference Standards

- A. ASTM B209 - Aluminum Alloy Sheet and Plate.
- B. FS TT-S-00230C - Sealing Compound: Elastomeric Type, Single Component.
- C. ASTM A176 - Stainless and Heat-Resisting Chromium Steel Plate, Sheet and Strip.
- D. BS 729 - "Hot - dip galvanized coatings on iron and steel articles".

1.04 Shop Drawings

- A. Submit shop drawings in accordance with Conditions of Contract.
- B. Clearly detail shaping, jointing, length of sections, fastening, and installation details.

1.05 Samples

- A. Submit samples in accordance with Conditions of Contract.
- B. Samples are to clearly indicate all fixing and sealing methods.

1.06 Existing Conditions/Protection

- A. Exercise care when working on or about roof surfaces to avoid damaging or puncturing membrane or flexible flashings.
- B. Place plywood panels on roof surfaces adjacent to work of this Section and on access routes. Keep in place until completion of work.

1.07 Guarantee/Warranty

- A. Provide Owner with a written guarantee stating that metal flashings will properly shed water and protect finish from physical damage for a minimum period of 10 years from date of Completion of Performance of Work, as certified by the Supervising Engineer\Owner's Representative, and that damage resulting from failure to provide above stated performances will be repaired or replaced to satisfaction of Owner at no additional cost.

PART 2 PRODUCTS

2.01 Sheet Metals

- A. Aluminum Sheet: ASTM B209; minimum 1.25 mm thick utility sheet of plain finish.

2.02 Accessory Materials And Components

- A. *Fasteners*: Concealed clip double seal type; of same material as flashings; sized to suit application.
- B. *Solder and Flux*: Type recommended for materials being used.
- C. *Bituminous Paint*: Acid and alkali resistant type; black color.
- D. *Sealant*: Two component polysulphide, non-staining; non-bleeding; non-sagging; of color selected by the Supervising Engineer\Owner's Representative.
- E. *Backing Rod*: closed Cell polyethylene foam with a tough non-porous skin. Over size to 50% of joint size.

2.03 Fabrication

- A. Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- B. Form sections in approved lengths. Make allowances for expansion at joints.
- C. Seams are to be flat lock type except corners. Fabricate corners minimum 455 mm x 455 mm mitered, soldered or welded, and sealed as one piece.
- D. Wipe and wash clean soldered joints to remove traces of flux immediately after soldering.
- E. Backpaint flashings with bituminous paint where expected to be in contact with cementitious materials or dissimilar metals.

PART 3 EXECUTION

3.01 Installation

- A. Secure flashings in place using specified type fasteners. Use exposed fastener in locations approved by the Supervising Engineer\Owner's Representative. When using exposed fasteners, they are to be of same finish as flashings.
- B. Fix metal flashings to form tight fit.
- C. Apply sealing compound at junction of metal flashings and concrete and/or plastered surfaces.
- D. Lock seams and end joints. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

END OF SECTION

SECTION 07900

Sealants

PART 1 GENERAL

1.01 Work Included

- A. Clean and prepare surfaces to receive sealant materials.
- B. Install sealant and backing materials in exterior concrete joints around perimeter of exterior located windows and door frames, exterior and interior joints between dissimilar materials and expansion joints.

1.02 Related Work

- A. Section 01340: Shop Drawings, product Data and Samples
- B. Section 08520: Aluminum windows, doors and louvers.

1.03 Reference Standards

- A. ASTM C804 - Recommended Practices for Use of Solvent - Release Type Sealants.
- B. ASTM D1056 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- C. ASTM D1565 - Specification for Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open Cell Foam).

1.04 Product Data

- A. Submit Product Data in accordance with Section 01340.
- B. Submit manufacturers descriptive literature; including surface preparation and installation instructions.

1.05 Warranty

- A. Provide written warranty in accordance with "Conditions of Contract".

1.05 Warranty (Cont'd)

- B. Warranty is to provide for repairing and replacing, at no cost to the Owner, sealants used for joints in Concrete which fails to perform as intended, because of either leaking, crumbling, hardening, shrinkage, bleeding, sagging, staining or loss of adhesion, within a minimum period of ten years from date of Substantial Performance of Work as certified by the Supervising Engineer\Owner's Representative.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

- A. The Contractor shall submit to the Supervising Engineer\Owner's Representative the names of three manufacturers and their products which will be acceptable under this Section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.02 Sealants Materials

- A. Sealant: Polysulphide base, one component, chemical curing; conforming to Shore "A" hardness of minimum 15 and maximum 50 non-staining and non-bleeding; color selected by the Supervising Engineer\Owner's Representative.
- B. Sealant: Polysulfide base, two component, chemical curing; type 1 - self levelling, 2 - non-sagging, conforming to Shore "A" hardness of minimum 15 and maximum 50 non-staining and color selected by the Supervising Engineer\Owner's Representative.
- C. Sealant: Polysulphide base, one component, air curing; conforming to Shore "A": hardness of minimum 15 and maximum 50; non-staining and non-bleeding; color selected by the Supervising Engineer\Owner's Representative.
- D. Sealant: Terpolymer base, multi-component, chemical curing; Type 1 - self levelling, Type 2 - non-sagging, conforming to Shore "A" hardness of minimum 15 and maximum 50; non- staining and non-bleeding; colors selected by the Supervising Engineer\Owner's Representative;
- E. Sealant: Silicone base, one component, solvent curing; conforming to requirements of class A; indicating an instantaneous Shore "A" hardness of maximum 50; non- staining; color selected the by the Supervising Engineer\Owner's Representative.
- F. Sealant: Silicone base, one component, chemical curing; conforming to requirements of class A; indicating an instantaneous Shore "A" hardness of maximum 50; non- staining; color selected by the Supervising Engineer\Owner's Representative.

2.02 Sealants Materials (cont'd)

- G. Sealant: Silicone base, two component, chemical curing; conforming to requirements of class A; indicating an instantaneous Shore "A" hardness of minimum 12 and maximum 25; non-staining; color selected by the Supervising Engineer\Owner's Representative.

2.03 Preparatory Materials

- A. Primers: Non-staining types recommended by sealant manufacturer to suit applications.
- B. Joint Cleaners: Non-corrosive types recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Filler: ASTM D1056 D1565 polyethylene foam rod; oversized to 50%; of joint size.

PART 3 EXECUTION

3.01 Preparation/Installation

- A. Maintain workmanship of the highest quality in accordance with best trade practice. Perform all work in accordance with ASTM C804.
- B. Clean and prepare joints in accordance with manufacturer's recommendations. Remove any loose materials and other foreign matter which might impair adhesion of sealant.
- C. Ensure that joint forming materials are compatible with sealant.
- D. Examine joint dimensions and size materials to achieve required width/depth ratios. Use joint filler to achieve required joint depths, to allow sealants to perform properly.
- E. Install sealant in accordance with manufacturer's recommendations. Use one part type sealant for up to 20mm joints. Use two part type sealant for over 20mm joints.
- F. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
- G. Form joints concave, free of air pockets, embedded matter, ridges and sags.

END OF SECTION

DIVISION 8
DOORS AND WINDOWS

Ref.	Description	Page No.		
08520	Aluminum Windows, Doors and Louvers	08520-01	thru	08520-04
08700	Hardware	08700-01	thru	08700-03
08800	Glazing	08800-01	thru	08800-03
08920	Structurally Glazed Aluminum Curtain Walls	08920-01	thru	08920-06

SECTION 08520

Aluminum Windows, Doors and Louvers

PART 1 GENERAL

1.01 Work Included

- A. Double glazed aluminum windows, complete with glass and glazing hardware as per general notes and drawings.
- B. Aluminum louvers.
- C. Install perimeter sealants.
- D. Install hardware as indicated.
- E. All Aluminum windows shall be powder coated of color as selected by the Supervising Engineer/Owner's Representative.

1.02 Related Work

- A. Section 08800 - Glazing.

1.03 Reference Standards

- A. ANSIO A134.1 Specifications for Aluminum Windows.
- B. ASTM A36 Structural Steel.
- C. ASTM B209 Aluminum-Alloy Sheet and Plate.
- D. ASTM B221 Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.
- E. DIN 17615 Part 1 – Manufacture of Extruded profiles.
- F. DIN 4108 Frame material group
- G. DIN 18055 Stress group
- H. DIN 4109 Sound insulation

1.04 Shop Drawings And Product Data

- A. Submit shop drawings and product data for the approval of the Supervising Engineer / Owner' Representative.
- B. Indicate pertinent dimensioning, general construction, component connections and locations, anchorage methods and locations, hardware locations, installation details.

1.05 Delivery Of Materials

- A. Deliver windows in Manufacturer's packaging complete with installation instructions.

1.06 Samples

- A. Submit full size sample of window corner construction, including opening section, indicating profile, size and jointing method. Also submit sample of each type of operable hardware, indicated style and finish.
- B. Submit color samples for color selection, powder coated finish for the Supervising Engineer \Owner's Representative's approval.

1.07 Guarantee/Warranty

- A. Attention is directed to the provisions of the conditions of contract regarding guarantees/warranties..
- B. Provide written Guarantee in the name of the Owner in accordance with the Conditions of Contact, covering all materials and workmanship used in the installation of the aluminum windows, for a period of ten (10) years from the date of final acceptance of this Project.
- C. Manufacturer's shall provide their standard Guarantee for the work under this section. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the Manufacturer and contractor may have by law or by other provisions of the Contract Documents.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

- A. The Contractor shall submit to the Supervising Engineer\Owner's Representative the names of three manufacturers and their products which will be acceptable under this Section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.02 Components And Materials

- A. Frames Sections will be designed to suit the installation with due allowance for wind loads, heights and location, of minimum 2.50mm thick extruded aluminum. (In accordance with DIN4108)
- B. Profiles shall be non thermally broken profiles.
- C. Operable Frames Sized and profiled to suit frames, complete with Manufacturer's standard type glass stops of size and profile to suit.
- D. External screws: To be A4 quality stainless steel
- E. Glass Stops (fixed lights) Manufacturer's standard screw-applied type, of size and profile to suit frames.
- F. Glass (Generally) As shown on drawings.
- G. Glazing Materials Manufacturer's standard type, to suit locations and applications.(Stainless steel, zinc, aluminum and polyamide)
- H. Bituminous Paint Acid and alkali resistant type, color as approved.

2.03 Fabrication

- A. Fabricate window units in conformance.
- B. Fabricate aluminum windows to allow for adequate clearances and shim spacing around perimeter of assemblies to enable proper installation. Allow for thermal movement within window construction.
- C. Provide expansion joints where required.
- D. Provide sufficient corrosion resistant anchorage devices to securely and rigidly fit windows in place.
- E. Accurately and rigidly fit together joints and corners. Match components carefully ensuring continuity of line and design. Ensure joints and connections are flush, hair line and weatherproof.
- F. Provide internal reinforcing, with steel members; ASTM A36 galvanized where required to maintain rigidity.
- G. Provide for moisture entering joints, and condensation occurring within frame construction to drain to exterior.
- H. Apply coat of bituminous paint on concealed aluminum surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.01 Installation

- A. Install aluminum windows in accordance with Manufacturer's recommendations, to achieve weather-tight installations. Ensure assemblies are plumb, level and free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- B. Install aluminum louvers in accordance with Manufacturer's recommendations. Ensure assemblies are plumb, level and free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- C. Install sufficient corrosion resistant anchorage devices to securely and rigidly fasten windows to building, without causing detrimental effects to shape or performance.
- D. Set window sills level and uniform. Accurately and rigidly fit together joints. Ensure joints are flush, hairline and weatherproof.
- E. Install sealants and related backing materials around perimeter of windows.

END OF SECTION

SECTION 08700

Hardware

PART 1 GENERAL

1.01 Work Included

- A. Hardware for exterior doors, windows, curtain walls, gates and other items not specifically mentioned herein but deemed to receive hardware.

1.02 Related Work

- A. Section 08920: Structurally Glazed Curtain Walls.
- B. Section 08520: Aluminum Windows, Doors and Louvers

1.03 Reference Standards

- A. ANSI A115.1 - Door and Frame Preparation for Mortise Door Locks for 45mm Doors.
- B. ANSI A115.2 - Door and Frame Preparation for Bored or Cylindrical Locks for 45mm Doors.
- C. ANSI A115.5 - Frame Preparation for 181 & 190 Series Deadlock Strikes.
- D. ANSI A115.7 - Door and Frame Preparation for Floor Closers, or Double Acting.
- E. ANSI A115.8 - Door and Frame Preparation for Floor Closer, Single or Double Acting.
- F. ANSI A156.1 - Butts and Hinges.
- G. ANSI A156.2 - Locks and Lock Trim.
- H. ANSI A156.3 - Exit Devices.
- I. ANSI A156.4 - Door Controls (Closers).

1.04 Samples

- A. Submit samples of each type of hardware required for job, in accordance with Section 01340.
- B. Indicate style and finish.

1.05 Shop Drawings And Product Data

- A. Submit shop drawings and product data in accordance with Section 01340.

1.06 Hardware Schedule

- A. Upon award of the contract the successful Contractor shall submit a hardware schedule for approval by the Supervising Engineer\Owner's Representative in accordance with Section 01340. Items shall be identified by:
 - Manufacturer - Catalogue Number - Size
 - Fastening - Finish
- B. Handing of door and window opening shall be the responsibility of the Contractor.

1.07 Keying

- A. Door locks: Master keyed, submit schedule for the Supervising Engineer's\Owner's Representative approval.
- B. Supply 3 keys for each lock.

1.08 Operation and Maintenance Data

- A. Provide the Supervising Engineer\Owner's Representative with manufacturer's parts list and maintenance instructions for each type of hardware supplied and necessary wrenches and tools required for proper maintenance of hardware.

PART 2 PRODUCTS

2.01 Hardware

- A. Provide items in accordance with hardware schedule prepared by hardware supplier, complete to function as intended.

2.02 Acceptable Manufacturers

- A. The Contractor shall submit to the Supervising Engineer\ Owner's Representative the names of three manufacturers and their products which will be acceptable under this Section. Approval of the manufacturer or product must be obtained before with associated work.
- B. Substitutions: Items of same function and performance are acceptable in conformance with Section 01630.

PART 3 EXECUTION

3.01 Installation

- A. Install hardware in accordance with manufacturer's recommendations, using proper templates.

END OF SECTION

SECTION 08800

Glazing

PART 1 GENERAL

1.01 Work Included

- A. Glazing for windows, curtain walls and doors

1.02 Related Work

- A. Section 08920: Structurally Glazed Curtain Walls.
- B. Section 08520: Aluminum Windows, Doors and Louvers

1.03 Reference Standards

- A. FS DD-G-451C - Glass, Plate, Sheet, Figured (Flat, for Glazing, Mirrors and Other Uses).
- B. FS TT-S-230A - Sealing Compound, Synthetic Rubber Base, Single Component, Chemical Curing For Caulking, Sealing and Glazing in Building Construction.
- C. FS TT-S-001543 - Sealing Compound, Silicon Base (For Caulking and Glazing in Buildings and Other Structures).

1.04 Guarantee/Warranty

- A. Provide written guarantee in accordance with Conditions of Contract, in the name of the Owner.
- B. Provide Ten (10) years warranty to include coverage for sealed glass units from seal failure, inter pane dusting or misting, and replacement of same.
- C. Provide Ten (10) year warranty to include coverage for de lamination of reflective glass and replacement of same.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

- A. The Contractor shall submit to the Supervising Engineer\ Owner's Representative the names of three manufacturers and their products which will be acceptable under this Section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.02 Specifications

- A. Glazing shall be as described in the drawings and bills of quantities.
- B. *Mechanical Connections* must be provided, designed to integrate the wall assembly. These must be manufactured from materials wholly compatible with glass and able to cope with and distribute the constant stress applied.
- C. Glass Performance Characteristics as following:

6mm thick tempered clear internal glass pane
12 mm thick cavity
6 mm thick tempered tinted external glass pane

Visible Light Transmittance	VLT	34%	
Reflection (out)	R-out	13%	
U-value "NFRC 100-2001 SUMMER "		2.0	w/m ² .K
Shading Coefficient	SC	0.44	

2.03 Glazing Compounds

- A. Silicon compound for all joints of glass walls, to the approval of the Supervising Engineer/Owner's Representative.
- B. Sealants, to the approval of the Supervising Engineer/Owner's Representative.

2.04 Glazing Accessories

- A. Setting Blocks: Neoprene; 80-90 Shore A durometer hardness; 9.5 mm long x width of glazing rabbet space minus 1.5mm x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene; 50 to 60 Shore A durometer hardness; 76 mm long x one half the height of the glazing stop x thickness to suit application.
- C. Glazing Splines: Manufacturer's standard dry glazing splines to suit aluminum extrusions.
- D. Glazing Tape: Preformed butyl type; NAMM #SS-1B-68, with integral spacing devices; Manufacturer's Standard size and color; 10-15 shore A durometer hardness.

PART 3 EXECUTION

3.01 Exterior Dry Method (Preformed Glazing Channel)

- A. Clean contact surfaces with solvent and wipe dry.
- B. Cut glazing spline to proper length and install on glass pane. Weld joints by butting channel and dabbing with sealant.
- C. Place setting blocks at 1/4 points with edge block no more than 150mm from corners.
- D. Rest glass on setting blocks, and push against stop with sufficient pressure to ensure full contact and adhesion at perimeter.
- E. Install removable stops, avoid displacement of glazing Spline, exert pressure for full continuous contact.

3.02 Interior Dry Method (Tape and Tape)

- A. Cut glazing tape to length and install against permanent stop, projecting 1.6 mm above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 150mm from corners.
- C. Rest glass on setting blocks and push against tape for full contact at perimeter of pane or unit.
- D. Place glazing tape on free perimeter of glass in same manner described above.
- E. Install removable stop, avoid displacement of tape, exert pressure on tape for full continuous contact.
- F. Knife trim excess or protruding tape.
- G. Glass walls are a specialist item. Installation must be carried out by trained experts in accordance with approved procedures. The walls must be supplied and installed under one contract accompanied by a ten year warranty for both material and installation.

3.03 Cleaning

- A. After installation mark glass with X by using tape or removable paste.
- B. Immediately remove droppings from finished surfaces. Remove labels after work is completed.

END OF SECTION

SECTION 08920

Structurally Glazed Aluminum Curtain Walls

PART 1 GENERAL

1.01 Work Included

- A. Design, fabricate, supply and install structurally glazed powder coated or aluminum curtain walls. The sub-structure shall be based on approved heavy duty extruded aluminum back sections with frontal glazing bar to suit 24 mm thick double glazed units, comprising 6 mm thick tinted tempered outer glass, 12 mm thick 'minimum' air space and 6 mm thick clear tempered inner glass, together with and including all metal anchors, hardware and accessories, for the full and proper execution of the works.
- B. Aluminum flashings as appropriate.
- C. Perimeter Sealants.
- D. Other requisite materials, equipment and labor, not specifically mentioned herein, but deemed to be necessary for the full and proper execution, completion and maintenance of the works.

1.02 Summary

- A. This Section includes comprehensive aluminum system of profiles for curtain walling.
- B. *Primary components of the glazed curtain wall system include:*
 - 1. Aluminum curtain wall framing system.
 - 2. Glazing Gaskets (EPDM in accordance with DIN 7863)
 - 3. Column covers, soffits, sills, copings, trim, and similar border and filler items.
 - 4. Anchors, shims, fasteners, inserts, accessories, and support bracket.
 - 5. Insulation and fire stopping within the curtain wall system.
 - 6. Joint sealing within the curtain wall system.
 - 7. Aluminum framed hinged and sliding doors included as part of the glazed aluminum curtain wall system.
 - 8. Glass and glazing included as part of the curtain wall system.

1.03 Reference Standards

- A. ASTM B221 : Aluminium - Alloy Extruded Bars, rods, wire, shapeard tubes.
- B. FS TT-S-00230: Sealing compound, elastomeric type, single component (for caulking, sealing and glazing in buildings and other structures).

Heavy duty extruded aluminum of alloy A1Msi 0.5 F22, anodization grade and in accordance with DIN 17615.

- C. ISO 6612 – ISO 6613
- D. BS 5368 – Parts 1-4
- E. Jordanian Standards 425/1985
- F. Jordanian Standards 423/1985
- G. Jordanian Standards 424/1985

1.04 Submittals

A. *Shop Drawings and Product Data:*

- 1) Submit shop drawings and product data for the approval of the Supervising Engineer / Owner' Representative.
- 2) Indicate pertinent dimensioning, layout, anchorages, construction details, method of installation and adjacent construction.
- 3) Indicate all units of curtain wall, their configuration and size, materials and types of anchorage items, and their locations.
- 4) Submit manufacturer's/supplier's installation instructions, and field erection drawings.

B. *Design Calculations*

1. Submit two copies of calculations, under seal and signature of the Professional CONSULTANT, showing following:
 - (1) Design load assumptions.
 - (2) Detailed engineering of mullions.
 - (3) Moment of inertial of mullions.
 - (4) Detailed engineering of anchorage hardware, clip angles, washers, anchor bolts, welds, torque pressure.
 - (5) Materials proposed and their allowable sheer and bending stresses.
 - (6) Deflections and expansion and contractions.
2. Prepare calculations in a clear, comprehensive manner to permit easy review. Incomplete or haphazard calculation will be rejected unreviewed.
3. Calculations must be submitted for approval prior to commencing the works.

1.04 Submittals (cont'd)

C. Samples

- 1) Submit two sets of double-glazed units to indicate the type of finish and materials used. One of the two duplicate sample sets approved by the Engineer will be retained by him at the project site, the other being returned to the manufacturer/suppliers for his guidance.
- 2) Anchors: Two of each type to be incorporated in the works.
- 3) Manufacturer's/Supplier's recommended cleaning agent and application procedure.
- 4) Submit samples of other materials specified herein upon request by the Supervising Engineer / Owner's Representative.

1.05 Guarantee/Warranty

- A. Attention is directed to the provisions of the Conditions of Contract regarding guarantees/warranties for the work.
- B. Provide written guarantee in the name of the Owner, in accordance with Conditions of Contract, covering all materials and workmanship used in the structural glazed curtain walls for a period of Ten (10) years from the date of final acceptance of this project.
- C. Manufacturers/Suppliers shall provide their standard guarantees for work under this Section. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the Manufacturer and Contractor may have by law or by other provisions of the Contract Documents.
- D. All warranties/guarantees to be issued by the Supplier, Manufacturers & Sub-Contractors shall be counter-signed by Main Contractor and both of them will be liable for repair/replace the items/works, etc. during the warrantee/guarantee period.

1.06 Qualifications

- A. Fabricate/Supplier and installer: A firm with a minimum of Ten (10) years successful experience in the fabrication/Supply and installation of structural glazed curtain walls works.

1.07 Design Criteria

- A. The method of fabrication and installation of the structural glazed curtain walls work shown on the Drawings is diagrammatic only and is not to be used for the purpose of bidding or construction. It shall be the responsibility of the Contractor to design and guarantee the structural support and the permanent water and air inflation and sealing of all glazing work. The installation shall be designed to allow for expansion, contraction and differential deflection of supporting floors of the building structure. All fastenings into aluminium sub-structure bolts, anchors, inserts, etc., are to be stainless steel.

- B. Performance: The following requirements shall apply:-
 - 1. *Structural Properties:* Deflection under design loading shall not exceed 1/175 of clear span.
 - 2. *Wind Loading:* The system shall be designed to withstand a wind load normal to the plane of the curtain wall equal to 45 m/s.
 - 3. *Thermal Movement:* Provide expansion and contraction due to temperature changes without detriment to appearance or performance for the temperature range of 50 degrees C.
 - 4. *Water Inflation:* No uncontrolled water inflation when subjected to a water spray at the rate of 5 gallons per hour per square foot of fixed wall area, and a static pressure of 20% of the design wind load, or 6.24 psf, or both.
 - 5. *Air Inflation:* Shall not exceed 0.06 CFM per square foot of fixed wall area under a static pressure of 1.56 psf (25 MPH wind).

1.08 Delivery, Storage And Handling

- A. *Packing and Loading:* Finished glazed units shall be carefully packed and loaded for shipment using all reasonable and customary precautions against damage in transit. No materials which may cause staining, scratching or discoloration shall be used for blocking or packing.
- B. *Site Storage:* The site storage of finished units shall not be allowed without the prior approval of the Engineer.
- C. *Defective Finished Units:* Any unit showing imperfections of any kind or whatever nature, upon receipt at the building site, shall be discarded and removed from the work site and at the Supplier's/Contractor own expense.
- D. Refer to the approved manufacturer's instructions in respect of transport and storage.

PART 2 PRODUCTS

- A. The Contractor shall submit to the Engineer the names of three manufacturers and their products which will be acceptable under this Section. Approval of the manufacturer or product must be obtained before proceeding with associated work.

3.0 FABRICATION

3.01 GENERAL

- A. Fabricate all components in compliance with approved shop drawings. Fabricate and assemble units with joints at intersections of members with uniform hairline connections. Shops fabricate units to greatest extent practicable.
- B. Insofar as practical, execute fitting and assembly in the shop with the various parts or assemblies ready for erection at the building site.
- C. Take field measurements and levels required to verify or supplement those shown on the drawings for the proper layout and installation of the work.
- D. Coordinate dimensional tolerances in adjacent building elements and confirm prior to the commencement of the work. Commencement of installation floor by floor shall be construed as acceptable of building conditions. Work shall not deviate from tolerances specified.
- E. Accurately machine, file, fit and securely frame together all joints, corners, miters.
- F. Location of exposed joints shall be to the approval of the Engineer.
- G. Make exposed work free of machine marks and dimpling.
- H. Fabricate components to avoid force fitting to obtain alignment with adjacent components.
- I. Fabricate curtain/window wall system and canopies, to allow for thermal movements within construction.
- J. Fabricate curtain/window wall, and canopies components allowing for accurate and rigid fit of joints and corners. Match components carefully ensuring continuity of line and design. Ensure joints and connections will be flush, hairline and weatherproof.
- K. Fabricate curtain/window system and canopies to collect and remove all water from within system to weep to exterior.
- L. Fabricate horizontal strip windows with continuous gutter and weep holes at glass sill, and with continuous gutter at glass head, which drains directly to exterior.
- M. Reinforcement: Reinforce aluminum work at anchorage and support-points, at joints and attachment points for interfacing work. Provide non-corrosive anchors for fasteners in aluminum less than 3mm thick.
- N. Reinforce all frames by concealed means as necessary to meet the specified design requirements.
- O. Provide steel brackets and support framing to fasten frames in place in opening. Provide slotted connections as required to accommodate deflection of opening components.

- P. Where frame members are lapped, the faces exposed to the weather shall be in full, tight contact. Allow minimal clearance for snap-on components.
- Q. Where mullions are extended and connected to the underside of the building structure above, provide slotted connections to accommodate structure deflection.
- R. Fabricate corner pieces and filler pieces of thick plate aluminum to the profiles shown, by welding prior to application of finish.
- S. Provide concealed clips for fastening plate assemblies in place.

End of Section

DIVISION 9

FINISHES

Ref.	Description	Page No.		
09220	Portland Cement Plaster	09220-01	thru	09220-04
09315	Porcelain Tiles	09310-01	thru	09310-03
09610	Stone Flooring	09610-01	thru	09610-08
09900	Painting	09900-01	thru	09900-06

SECTION 09220

Portland Cement Plaster

PART 1 GENERAL

1.01 Work Included

- A. Three coat cement plaster with wood float trowelled finish coat.
- B. Coloured stucco

1.02 Related Work

- A. Section 03300: Cast-in-place concrete.

1.03 Reference Standards

- A. ASTM C150 - "Portland Cement".
- B. ASTM C144 - "Sand for Cement Plaster Work".
- C. ASTM C6 - "Normal Finishing Hydrated Lime".
- D. ASTM C206 - "Special Finishing Hydrated Lime".
- E. ASTM C35 - "Inorganic Aggregates for Use In Gypsum Plaster".
- F. UL - "Underwriters' Laboratories Incorporated".
- G. ASTM C631 - "Bonding Compounds for Interior Plastering".

1.04 Sample Panel

- A. Construct sample panel with finished surface, using materials and methods specified herein as per Engineer's Instructions.
- B. Accepted surface finish of sample establishes minimum standard of quality and workmanship of cement plaster work on job.

1.05 Environmental Conditions

- A. Provide sufficient heat and ventilation in areas where work of this Section is being performed, so as to allow cement plaster to properly cure. Take precautionary measures necessary to ensure that excessive temperature changes do not occur.

PART 2 PRODUCTS

2.01 Basecoat Materials

- A. Cement: Normal - Type I. Portland type, conforming to requirements of ASTM C150; grey color.
- B. Hydrated Lime: Normal finishing type conforming to requirements of ASTM C6, or an approved mortar plasticiser, both types pending the Supervising Engineer's/Owner's Representative approval.
- C. Water: Clean, potable fresh and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.
- D. Sand: Shall conform to ASTM C-144, except that the gradation shall meet further requirements for cement plaster work.
- E. Bonding Agent: Type recommended for satisfactorily bonding cement plaster to concrete surfaces. Conforming to ASTM C631. Feb products or approved equal.

2.02 Finishing Plaster Materials

- A. Cement and Sand as specified in 2.01, items "A" and "D".

2.03 Metal Accessories

- A. Angle Beads, Corner Mesh and Plaster stops: Minimum 0.50mm thick steel with rust inhibitive coating of longest possible lengths; sized and profiled to suit application. Angle beads to have bullnosed edges.
- B. Expansion Joints: Back to back plaster stops of longest possible lengths.
- C. Anchorages: Nails, staples, or other metal supports, of type and size to suit application and to rigidly secure metal accessories in place.

2.04 Cement Plaster Mixes

- A. Mix and proportion cement plaster as follows: (by volume).
 - 1. Base coat: 1 part cement, to 2 parts sand, using an approved plasticiser, MBT Products or approved equal.
 - 2. Second coat: 1 part cement to 4 parts sand with an approved plasticiser.
 - 3. Finish coat: 1 part cement, to 4 parts sand with an approved plasticiser.
- B. Mix only as much plaster as can be used in one hour.
- C. Mix materials dry, to uniform colour and consistency, before adding water.
- D. Add color pigments in accordance with manufacturer's recommendations. Ensure uniformity of mix and coloration.
- E. Protect mixes from frost, dust and evaporation.
- F. Do not retemper mixes after initial set has occurred.
- G. Where hydrated lime is accepted and approved by the Supervising Engineer/Owner's Representative, the volume of lime must not exceed 0.5 that of cement volume for the base course, and 1.0 that of cement volume for the second and third coats.
- H. For two coats plaster use items 1 and 2 of "A" above.

PART 3 EXECUTION

3.01 Preparation

- A. Prior to application ensure mechanical and electrical services behind surfaces to receive cement plaster have been tested and approved.
- B. Clean concrete surfaces of dust, laitance, efflorescence, loose particles, grease or other foreign matter. Thoroughly wet surfaces before using acid solutions, solvents or detergents to perform cleaning. Thoroughly wash surfaces with clean water immediately following their use. Ensure mortar joints are flush.
- C. Roughen smooth concrete surfaces so as to allow adequate adhesion. Use method acceptable to the Supervising Engineer/Owner's Representative.
- D. Apply a bonding agent on concrete surfaces which are to receive cement plaster. Apply in accordance with manufacturer's recommendations, ensuring complete coverage.
- E. Ensure metal lath has been properly installed and rigidly secured.
- F. Wet Concrete surfaces to reduce excessive suction.
- G. Place metal accessories true to lines and levels.

3.02 Plastering

- A. Apply cement plaster using two coat system or three coat system as specified.
- B. Apply each bonding basecoat to minimum thickness of 5 mm. Other coats at 10mm thick. Moist cure and allow each coat to slowly dry for minimum period of 24 hours.
- C. Allow each coat to cure for minimum 3 days prior to application of the following coat.
- D. Evenly dampen each coat, to ensure uniform suction, and apply the following coat. Apply to thickness sufficient to secure required texture but in no case less than 3 mm. Apply finish coat subject to requirements.
- E. Maintain surface flatness, with maximum variation of 3.2mm in 3.000 m.
- F. Provide surfaces receiving paint with a steel trowel finish, to match approved sample pane.
- G. Avoid excessive working of surface. Delay trowelling as long as possible to avoid drawing excess fines to surface.
- H. Moist cure finish coat for minimum period of 48 hours.

3.03 Fire Rated Assemblies

- A. Perform cement plaster work for fire rated assemblies in accordance with drawings and as recommended by Underwriter's Laboratories.

END OF SECTION

SECTION 09310

Porcelain Tiles

PART 1 GENERAL

1.01 Work Included

- A. Porcelain tile flooring, installed using cement sand mortar with high quality ready made plastic grouted joints.
- B. Approved Adhesive Material.

1.02 Related Work

- A. Sealants for control and expansion joints, including back-up materials in conjunction with interior works.

1.03 Reference Standards

- A. Jordanian specifications
- B. TCA137.1 - Recommended Standard Specifications for Ceramic Tile.
- C. ISO 13006 and ISO 10535 (Method of Testing)
- D. Jordanian Standards 374/2000 and 375/2000 (Method of Testing)

1.04 Samples

- A. Submit full size samples of porcelain tiles for the approval of the Engineer / Owner representative. Submit in accordance with Section 01340.

1.05 Environmental Conditions

- A. Provide sufficient heat and ventilation in areas where work of this section is being performed, so as to allow porcelain tile to properly set. Take all precautionary measures necessary to ensure that excessive temperature changes do not occur.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

A. Approved Manufactures

1. Marca Corona "Italy"
2. Marazzi "Italy"
3. Gres de Aragon "Spain"
4. Roca "Spain"

or approved equal

- ### **B. Approval of the manufacturer or product must be obtained before proceeding with associated work.**

2.02 Materials And Components For Floors

- ### **A. Setting Bed: Cement sand mortar as approved by the Supervising Engineer/Owner's Representative.**
- ### **B. Grout: high quality ready made plastic grout; color selected by the Supervising Engineer/Owner's Representative; uniform in color and resistant to shrinking (preparation, mixing and placing should be as instructed by the manufacturer).**
- ### **C. Water: Clean, fresh and free of deleterious substances.**

PART 3 EXECUTION

3.01 Installation

- A. Prior to installing floor tile, ensure surfaces are level, with maximum surface variation of 6mm in 3.00 meters, and are steel trowelled. Ensure surfaces slope to drains.
- B. Ensure surfaces are clean and well cured.
- D. Do not commence until surface conditions are within tolerances required for proper installation.
- E. Neatly cut tile around fixtures and drains. Accurately form corners, base, intersections and returns.
- F. Ensure tile joints are uniform in width, subject to normal variance in tolerance allowed in tile size. Ensure joints are watertight, without voids, cracks, excess mortar or grout.
- G. Sound tile after setting. Remove and replace hollow sounding units.
- H. Keep expansion/contraction control joints free of mortar or grout.
- I. Allow tile to set for a minimum of 48 hours prior to grouting.
- J. Completed installation to be free of broken, damaged or faulty tile.

END OF SECTION

SECTION 09610

STONE FLOORING

PART 1 GENERAL

1.01 Work Included

- A. Stone floor finish (sizes and type as indicated in the Bill of Quantities).
- B. Mortar bed and joint pointing.

1.02 Related Work

- A. Section 04100 - Mortar
- B. Section 07900 - Sealants.

1.03 Reference Standards

- A. Applicable provisions of the following standard publications shall apply throughout the work:
 - 1. Ministry of Public Works. The General Technical Specifications for buildings, section 5, volume I, STONWORK; "Recommended Practices for the use of Natural Stones in Building Constructions".

1.04 Submittal

- A. General: Refer to Section 01340 - Shop drawings - Product Data and Samples for submittal provisions and procedures.
- B. Shopdrawings:
 - 1. Submit shop drawings in accordance with conditions of contract. Shop drawings shall clearly indicate expansion joints' dimensions and locations.
 - 2. Indicate pertinent dimensioning, layout, construction details, and adjacent construction.
 - 3. Indicate all units of stone, their configuration and size.
 - 4. Submit manufacturer's instructions for use of pointing colour and admixtures.
- B. Mockup:
 - 1. Furnish and install a typical stone floor application required for the project at area designated by the Engineer / Owner Representative. The panel shall be constructed for Engineer's / Owner Representative approval showing 1.0m x 1.0m for floor installation.

2. All work shall include setting and jointing all stone including final cleaning as specified herein for the actual work and as required for approval. Construct as many mock-ups until approval by the Engineer/ Owner Representative has been obtained.
3. The approved mock-up shall constitute the quality of work to be expected throughout the entire project, and shall remain in place for visual inspection until no longer needed as directed by the Engineer/ Owner Representative. The removal and disposition of the mock-ups shall be done by the Contractor at his expense without additional cost to the Owner.

1.05 Guarantee / Warranty

- A. Attention is directed to the provisions of the CONDITIONS OF CONTRACT regarding guarantees/warranties for the Works.
- B. All warranties/guarantees to be issued by the Supplier, Manufacturers and sub-contractors shall be counter-signed by Main Contractor and both of them will be liable for repair/replace the items/works, etc., during the warranty/guarantee period.

1.06 Qualifications

- A. Supplier/Fabricator: A firm having an adequate supply of the specified types of stone and an annual rated production capacity to deliver the stone to the project site on schedule within a time limit established by the Engineer/Owner Representative as required assuring no delay in the progress and completion of the Work.
- B. Installer: A Firm with a minimum of five years successful experience in the installation of stone pavers.

1.07 Design Criteria

- A. The method of installation of all stone pavers shown on the Drawings is diagrammatic only and is not to be used for the purpose of bidding or construction. It shall be the responsibility of the Contractor to guarantee the structural support and the permanent watertight sealing of all stone pavers. The installation shall be designed to allow for expansion and contraction of supporting floors of the paved areas.

1.08 Delivery, storage and handling

- A. Packing and Loading: Finished stone shall be carefully packed and loaded for shipment using all reasonable and customary precautions against damage in transit. No material which may cause staining or discoloration shall be used for blocking or packing.
- B. Site Storage: Upon receipt at the building site or storage yard, the stone shall be stocked on timber or platforms at least 100 mm above the ground, and extreme care shall be taken to prevent staining during storage. If storage is to be for a prolonged period, polyethylene or other suitable plastic film shall

be placed between any wood and finished surfaces, and shall be used also as an overall protective covering.

- C. Salt shall not be used for melting of ice formed on pieces, or for any purpose involving its contact with the stone.
- D. Defective Stone: Any piece of stone showing flaws, cracks, or imperfections such as vents, sand and clay holes, shelly bars, shakes, mottle, seams or starts upon receipt at the storage yard, or at the area to be paved, shall be discarded and removed from the work site, and at the Contractor's own expense.

1.09 Environmental Requirements

- A. The following environmental requirements are applicable to stone set in mortar, and when caulking stone joints with sealant.
- B. During freezing or near freezing weather provide equipment and cover to maintain a minimum of 4 degrees C and to protect stone work completed or in progress.
- C. At end of working day, or during rainy weather, cover stone work exposed to weather with waterproof coverings, securely anchored.
- D. Maintain materials and surrounding air to a minimum 10 degrees C prior to, during and 48 hours after completion of work.

PART 2 PRODUCTS

2.01 Stones Materials and Fabrication

- A. General:
 - 1. Stone shall be of good quality, sound, free from cracks and defects, seams or starts which may impair its structural, integrity, durability, appearance or function colour, texture and finish shall be within the range of samples approved by the Engineer/Owner Representative.
 - 2. All stone shall be obtained from quarries having adequate capacity and facilities to meet the specified requirements. Cutting and finishing shall be performed by using approved equipment to process the material promptly on order and in strict accordance the specifications. Evidence to this effect shall be provided by the Contractor.
 - 3. Stone rejected for noncompliance with the submitted samples or the requirements of this Specification shall be replaced with material acceptable to the Engineer/Owner Representative. Replacement shall be prompt and at the Contractor's own expense. Inspection of stone by the Engineer/ Owner Representative shall not relieve the Contractor of his responsibility to perform all work in accordance with the Contract Documents.
- B. Stone Schedule:

Refer to the Drawings for locations, sizes and thicknesses of the various types of stone specified herein. All stone work shall be carried out in accordance with the classification of Class "Special" refer to clause 1.06, Item A/1:

Stone Type Application/Thickness/Finish

1. "Local Ajloun Stone":

Application: Stone tiles set in mortar and sand fill materials.

Thickness: As shown on the relevant drawings.

Finish: As shown on the relevant drawings.

C. Stone:

1. The finish of exposed to view surfaces of stone shall be as specified above. The concealed from view surfaces of all stone types shall be sawn, hacked and/or roughened to allow key for the mortar bed.

2. End matches the texture in the face of stone elements that abut one another to assure continuity in surface appearance.

D. Stone Fabrication – General

1. Fabrication of stone shall be in strict accordance with approved shop drawings for fabrication, and with this specification.
2. To the maximum extent possible, fabrication and assembly of stone shall be executed on site to maintain the approved pattern and to compensate for field conditions.
3. All work shall be of the highest quality, in accordance with the best trade practices, and performed by skilled workmen. All materials and workmanship shall conform to the highest industry standards, including the Jordan General Specifications-1996. Recommended Practices for the Use of Natural Stone in Building Construction.
4. Use no materials, equipment, or practices that may adversely affect the functioning, appearance, or durability of the stone work or work of other trades.

E. Dimensions: Cut all stone work accurately to shape and dimensions shown on the final approved shop drawings. Exposed plane surfaces shall be true. Bed and joint surfaces shall be dressed straight and at right angles to the faces, unless otherwise shown. Exposed arris lines shall be sharp and true. Patching of stone will not be permitted.

F. Beds & Joints: Stone beds and joints surfaces shall be cut square from the face for the entire thickness of stones. Stone shall be bedded and jointed, including the various expansion joints dimensions as shown on the approved drawings.

G. Backs of Pieces: Backs of all pieces of stone, shall be sawn to approximately true planes with a maximum of 1.5mm in thickness from that indicated on the approved shop drawings.

2.02 Mortar Material and Accessories

A. Cement

1. Cement for Setting Mortar: Non staining Portland Cement conforming to Jordan General Specifications-1996 except containing not more than 0.03% water soluble alkali.
2. Cement for Pointing Mortar: Non staining white Portland Cement conforming to Jordan General Specifications-1996.
Gray non staining cement may be used for pointing mortar if the colour of pointing mortar, as selected by the Engineer/Owner Representative, does not require White Portland Cement.
2. The specified cement shall fulfill further requirement that it shall exhibit no efflorescence when cast into the form of 51mm X 179mm X 13mm slabs comprising the cement under test.
- B. Water: Shall be potable, clean and fresh from Public Water System.
- C. Sand: Well graded non staining masonry sand conforming to Jordan General Specifications-1996. Use white Silica sand for pointing mortar. No other sand shall be permitted for mortar or grout unless otherwise tested and approved by the Engineer/Owner Representative.
- D. Lime: Approved brand of plastic hydrated, conforming to Jordan General Specifications-1996.
- E. Grout for Stone Pavers: Permixed commercial expanding agent.

PART 3 EXECUTION

3.01 Conditions at Site

- A. The Contractor shall, prior to proceeding with the stone installation, examine all surfaces and parts of the areas to receive stone work, and notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the work. Do not proceed with installation until such conditions have been corrected and are acceptable to the Engineer/Owner Representative.
- B. Verify all measurements and dimensions, coordinate the installation of this work, and coordinate and schedule this work with the work of other trades. Give particular attention to the location and size of cutouts required to accommodate mechanical, electrical, and other work or adjoining construction, in accordance with the approved shop drawings for such trade.

3.02 Stone Installation

- A. Preparation For Stone Installation
Clean stone prior to setting, leaving edges and surfaces free from dirt and foreign material. Do not use wire brushes which mark or damage exposed surfaces, unless otherwise approved by the Engineer/Owner Representative.
- B. Mortar and Grout Proportioning
 1. General: Mortar grout proportioning shall be prepared and tested by the Contractor, and in addition the Contractor shall allow for preparing and testing the

mortar and grout mixes included within this section, to meet the Engineer/Owner Representative's satisfaction and approval.

2. Setting Mortar for Stone:

- a. Portland Cement - 1 part
- b. Hydrated Lime - 0-0.25 part
- c. Sand - 3 parts
- d. Plasticiser
- e. Integral water proofer

3. Fine Grout: Fine grout shall be mixed in the following proportions by volume all in accordance with Jordan General Specifications-1996.

- a. White Portland Cement - 1 part
- b. Sand - 1.0-1.5 parts (as approved by the Engineer/Owner Representative)
- c. Add color additive to acquire the color of mortar approved by the Engineer/Owner Representative

4. NOTE: Add integral waterproofing admixture to setting and grouting mortar in the quantity and manner recommended by the manufacturer.

5. Generally, febmix admix mortar plasticiser shall be used in all mortars, unless otherwise instructed by the Engineer/ Owner Representative.

C. Mortar and Grout Mixing:

1. Mortar and grout shall be machine mixed. Cement and hydrated lime may be batched by the bag. Sand preferably shall be batched by weight, but subject to the approval of the Engineer/ Owner Representative may on certain small operations be batched by volume in suitably calibrated containers, provided proper allowance is made for weight per cubic foot, contained moisture, bulking and consolidated. Shovel measurement shall not be used.
2. Workability or consistency of mortar on the board shall be sufficiently wet to be worked under the trowel. Water for tempering shall be available at all times. Mortar and grout which has begun to "set" shall be discarded. Mortar and grout which has stiffened due to evaporation shall be re tempered to restore its workability. Re tempering of mortar and grout at the mixer shall not be permitted.

D. Setting Exterior Stone Pavers: Set stone with mortar setting bed onto concrete substrate in the following manner.

1. Place setting bed mix onto a slightly water dampened concrete substrate surface or onto fluid applied membrane with protection board, as applicable. Setting bed shall be slightly thicker than the required thickness and parallel to the finish stone surface.
2. Lay out stone work in pattern shown on approved shop drawings. Perform field cutting of stone as required to maintain the approved pattern and to compensate for field conditions.
3. Accurately form intersections and returns. Perform cutting and drilling of stone without marring visible surfaces. Carefully grind cut edges of stone abutting trim, finish or built-in items for straight aligned joints. Fit stone closely to electrical

outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap stone.

4. Apply a dope coat, consisting of cement and water, to the bottom of each stone unit and place into freshly installed setting bed. Tap stone unit lightly to a true surface. Leveling of stone shall be done as the setting operation proceeds so that it is not necessary to disturb the stone units previously set. Grouting shall not be done until under bed sets and hardens for 24 hours or more.
5. Unless otherwise indicated, stone shall be set with 2mm joints. Refer to the approved shop drawings for stone joint dimensions.
6. Allow stone units to set overnight and then completely fill joints with pointing mortar. Surfaces of stone shall be cleaned to remove mortar spills from face of stone.
7. Remove and replace stone units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
8. Protect stone from discoloration or damage during construction and until acceptance of the Work.
9. Allowable Variations in Finished Work: Do not exceed the following deviations from level locations, slopes and alignments shown:
 - a. Floors: Maximum variation from horizontal plane of units to adjacent unit: plus or minus 0.8mm Plus or minus 3mm in 3048mm run, in any direction, at any location.
 - b. Joints: plus or minus 1mm variation in alignment of joints, in 1000mm.

3.03 Protection

- A. Stone shall at all times be protected from drippings, welding spatter and damage by other trades during construction. Where necessary or directed, substantial non staining wooden or other approved covering shall be placed to protect the work. Heavy polyethylene film shall be used between stone and wood. Maintain all protection until removed to permit final cleaning of stone work.

3.04 Cleaning

- A. Clean soiled surfaces using non-acidic solution of type which will not harm stone, mortar joint materials, or adjacent surfaces.
- B. Use non-metallic tools in cleaning operations.

3.05 Final Inspection

- A. Finished surfaces shall show no objectionable visual distinction in jointing, bedding, plane, colour, texture, pattern, and finish. All units and stones which in the opinion of the Engineer/Owner Representative do not provide the required uniformity shall be relocated, or removed and replaced with new stone units to the satisfaction of the Engineer/Owner Representative and at the Contractor's own expense.

- B. All defective stone shall be replaced with new stone units, except that minor damages may be repaired when approved by the Engineer/ Owner Representative. Repairs, when approved, shall be completed to the satisfaction of the Engineer/ Owner Representative. When the repairs to stone are unsatisfactory to the Engineer/ Owner Representative, the stone shall be replaced with new stone. All repairs and all replacements of defective and unsatisfactorily repaired stone shall be performed at the Contractor's own expense.

END OF SECTION

SECTION 09900

Painting

PART 1 GENERAL

1.01 Work Included

- A. Prepare surfaces which are to receive finish.
- B. Supply and apply paint finish in accordance with the finishing schedule.
- C. Spot priming and painting of materials delivered to the site, factory finished.
- D. Stopping and filling where necessary.
- E. Knotting.
- F. Emulsion paint / washable water repellent emulsion paint on plastered concrete surfaces, internally.

1.02 Mock-Up

- A. Before proceeding with paint application, finish one complete surface of each color scheme required, clearly indicating selected colors, finish texture, materials and workmanship.
- B. If approved, sample area will serve as a minimum standard for work throughout building.

1.03 Samples

- A. Prepare 500mm x 500mm samples of finishes when requested by Supervising Engineer/Owner's Representative. When possible, apply finishes on identical type materials to which they will be applied on job.
- B. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.
- C. Colors to be selected by Supervising Engineer\Owner's Representative prior to commencement of work.

1.04 Maintenance Materials

- A. Leave on Premises, where directed by Supervising Engineer/Owner's Representative, not less than one (1) five liter can of each color used, for maintenance use by the Owner after Defects Liability Period.
- B. Containers to be tightly sealed and clearly labeled for identification.

1.05 Delivery, Storage And Handling

- A. Deliver paint materials in sealed original labeled containers, bearing manufacturer's name, type of paint, brand name, color designation and instructions for mixing and/or reducing.
- B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 7 degrees C in well ventilated area.
- C. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.06 Environmental Conditions

- A. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture contents of surfaces are below following maximums:
 - 1) Plastered surfaces: 12%
- B. Ensure surface temperatures or the surrounding air temperature is above 5 degrees C before applying finishes. Minimum application temperatures for latex paints for interior work is 7 degrees C and 10 degrees C for exterior work.
- C. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 7 degrees C for 24 hours before, during and 48 hours after application of finishes.

1.07 Protection

- A. Before painting is commenced floors shall be swept and washed over; surfaces to be painted shall be cleaned before applying paint as specified, and all precautions taken to keep down dust whilst work is in progress.
- B. No paint shall be applied to surfaces structurally or superficially damp and all surfaces must be ascertained to be free from condensation efflorescence, etc. before the application of each coat.
- C. No painting shall be carried out externally during humid, rainy, damp foggy or freezing conditions, or conditions where surfaces have attained excessively high temperatures or during dust storms.

1.07 Protection (cont'd)

- D. No dilution of paint materials shall be allowed unless stated otherwise and except strictly as detailed by the manufacturer's own direction, either on the containers, or their literature, and with the special permission of the Engineer. For external work dilution of paints will not be allowed whatsoever. For internal work, where permitted by the Engineer, undercoats may be thinned by the addition of not more than 5% thinners. Gloss finish shall not be thinned at all.
- E. Plaster work shall be prepared by removing all loose friable materials by wire brushing/sanding. Surfaces are to be cleaned to remove dust, dirt, oil grease, etc.
- F. Adequately protect other surfaces from paint and damage. Repair damage as a result of inadequate or unsuitable protection.
- G. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.
- H. Place cotton waste, cloths and material which may constitute a fire hazard in closed metal containers and remove daily from site.
- I. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items are to be carefully stored, cleaned and replaced on completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.

1.08 Guarantee/Warranty

- A. All warranties/guarantees to be issued by the Supplier, Manufacturers and Sub-Contractors shall be countersigned by Main Contractor and both of them will be liable for repair/replace the items/works, etc., during the warrantee/guarantee period.

PART 2 PRODUCTS

2.01 Acceptable Manufacturers

- A. Approved Manufactures
 - 1. Jotun "Norway"
 - 2. Dulux "Australia"
 - 3. Terraco "Sweden"or approved equal
- B. Approval of the manufacturer or product must be obtained before proceeding with associated work.

2.02 Materials

- A. Paint Accessory Materials: (Linseed oil, shellac, turpentine and other materials not specifically indicated herein but required to achieve the finishes specified) of high quality and approved manufacturer.
- B. Paints: Ready-mixed except field catalysed coatings. Pigments fully ground maintaining a soft paste consistency, capable of readily and uniformly dispersed to a complete homogeneous mixture.
- C. Paints to have good flowing and brushing properties and be capable of dry or curing free of streaks or sags.

PART 3 EXECUTION

3.01 Inspection

- A. Thoroughly examine surfaces scheduled to be painted prior to commencement of work. Report in writing to Supervising Engineer/Owner's Representative, any condition that may potentially affect proper application. Do not commence until such defects have been corrected.
- B. Correct defects and deficiencies in surfaces which may adversely affect work of this section.
- C. No priming coats shall be applied until the surface have been inspected and the preparatory work has been approved by the Engineer. No undercoats or finishing coats shall be applied until the previous coat has been similarly inspected and approved.

3.02 Preparation Of Surfaces

- A. Preparation of surfaces shall be as per the Manufacture's recommendations.

3.03 Paint Application

- A. Each coat of paint shall be so applied as to produce a film of uniform thickness. All paint shall be applied in accordance with the manufacturer's instructions. Special attention shall be given to ensure that all surfaces including edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of adjacent painted. Surfaces paint to plaster is to brush applied.
- B. Each coat of paint is to be slightly darker than preceding coat unless otherwise approved by Supervising Engineer/Owner's Representative.
- C. Sand lightly between coats to achieve required finish.
- D. Do not apply finishes on surfaces that are not sufficiently dry.
- E. Drying :

1. All coats shall be thoroughly dried before succeeding coats are applied. Allow a minimum of 24 hours between application on any one surface, unless otherwise specified by the manufacturer.

F. Plastered Surfaces :

1. Plastered surfaces shall be rubbed down smooth and any cracks cut out and filled. The Contractor shall also apply one coat (at least) of Tropoline Putty Filler to the plastered surface prior to the application of paint to provide an absolutely smooth surface. (Refer to Manufacturer's recommendations)

G. Colors :

1. The colour will be selected by the Owner and/or the Engineer from the paint manufacturer's standard colour range.

H. Protection:

1. Proper care must be taken to protect surfaces while still wet by the use of screens, and 'wet paint' signs where necessary.

I. Damage:

1. Care must be taken when preparing surfaces, or painting, etc. not to stain or damage other work. Dust sheets and covers to the satisfaction of the Engineer shall be used to protect adjacent work. Any such stains or damage shall be removed and made good at the Contractor's expense.

J. Cleanliness:

1. All brushes, tools, pails kettles and equipment shall be clean and free from foreign matter. They shall be thoroughly cleaned after use and before being used for different color's types or classes or material. Painting shall not be carried out in the vicinity of other operations that may cause dust. Waste liquids, oil soaked rag, etc., shall be removed from the building each day. Waste liquids shall not be thrown down any sanitary fittings or drains.

Paint Application (cont'd)

K. Performance :

1. If, while the work is in progress, the paint appears to be faulty, such as consistency of colour, drying time or quality of finish, the work shall be stopped at once and the manufacturer consulted.
2. The manufacturer of the materials shall be given every facility for inspecting the work during progress in order to ascertain that the materials are being used in accordance to their directions, and to take samples of their products from the site if they so desire for tests.
3. The finishing coats of the various paints or surface finishing shall be free from sags, brush marks, runs, wrinkling, dust, bare or 'starved' patches, variations in colour and texture, and other blemishes.
4. When the work has been completed, the finished surfaces shall not be inferior in quality, colour and finish to the samples approved by the Engineer, and imperfections in manufacture shall not be apparent through these finished surfaces. In the event the Engineer is not satisfied with the quality of finish (does not comply with the required standards and/or the sample panel) the Contractor will be required to repaint at his own expense, such work to the satisfaction of the Engineer. in the opinion of the Engineer it is necessary to remove completely the unsatisfactory paint work this shall also be done under the direction of the Engineer at the expense of the Contractor.

3.04 Cleaning

- A. As work proceeds and upon completion, promptly remove paint where spilled, splashed or spattered.
- B. During progress of work keep premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.
- C. Upon completion of work leave premises neat and clean, to the satisfaction of Supervising Engineer/Owner's Representative.

END OF SECTION

DIVISION 15
MECHANICAL WORKS

Ref.	Description	Page No.		
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15410	Drainage System	15410-01	thru	15410-17
15650	HVAC Refrigeration	15650-01	thru	15650-05



Section 15100

Pipe Works Specifications



Pipe Works Specifications

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1. Pipe Works Fittings

1.1 Schedule Of Instrumentation

<u>Item</u>	<u>Location</u>
Pressure Gauges,	inlet and outlet of each pump
	inlet and outlet of each chiller evaporator
	inlet and outlet of each chiller condenser
	inlet and outlet of each heat exchanger
	inlet and outlet of each preheat coil
	let and outlet of each cooling coil
	inlet and outlet of each reheat coil
	upstream and downstream of each pressure reducing valve station

Note: Gauge cocks only are to be installed at reheat coils in hung ceilings.

Thermometers	each pump header
	inlet and outlet of each chiller evaporator
	inlet and outlet of each chiller condenser
	inlet and outlet of each heat exchanger
	inlet and outlet of each preheat coil
	inlet and outlet of each cooling coil
	inlet and outlet of each reheat coil
	supply fan discharge duct
	return fan intake duct

SCHEDULE 1:

Schedule of Valves and Appliances

Pressure rating of all valves and appliances shall be suitable for the operating conditions of which they will be installed, and shall not be less than the specified PN rating.

	Size (DN)	Valve / Fitting Details	Application	BS No.	PN
Domestic Water Systems	Up to 50	Bronze gate valve; non-rising extended stem; to 5154 Series 13 screwed (F) screwed Bonnet; one piece wedge; ends screwed BS 21 Taper thread stainless steel trim and spindle. In compliance with NSF or NRC	Isolating	5154	16
		Or Ball valve DZR copper alloy body, extended stem, with hard chrome plate full bore ball, PTFE seat and stem seal, screwed end to BS 21 or ANSI B2.1 NPT In compliance with NSF or NRC			
	65 - 500	BS 5154 and BS 5150 (flanged) high-grade cast iron bodies, epoxy painted inside with full way bore, stainless steel trim and spindle. In compliance with NSF or NRC	Isolating	5150	16
		Cast iron butterfly valve; replaceable elastomer seat, hand wheel and gearbox operated; 'U' water type, through bolted. Fully lugged, tapped for end of line service where specified. In compliance with NSF or NRC	Isolating/ Throttling	5154	16
	50 - 150	Cast iron straight pattern globe valve; bronze trim; Flanged BS 4504 stainless steel trim and spindle. In compliance with NSF or NRC	Pump discharge Throttling and Isolating	5152	16
	150 - 400	Cast iron butterfly valve; replaceable elastomer seat, hand wheel and gearbox operated; 'U' water type, through bolted. Fully lugged, tapped for end of line service where specified. In compliance with NSF or NRC	Isolating/ Throttling (High Duty)	1873	16
	200-450	Balancing valve with position indicator drain connection & 2 No. pressure cocks complete with plug type disc with logarithmic characteristic In compliance with NSF or NRC	Regulating valves	5155	16
	80-250	Cast iron butterfly valve; replaceable elastomer seat; 50 - 100mm lever operated, 150- 300mm hand wheel and gearbox operated; 'U' water type, through bolted. Fully lugged, tapped for end of line service where specified. In compliance with NSF or NRC	Isolating and Coarse throttling	5155	16

SCHEDULE 1: (Cont.)

Schedule of Valves and Appliances

Pressure rating of all valves and appliances shall be suitable for the operating conditions of which they will be installed, and shall not be less than the specified PN rating.

Service	Pipe Range	Pipe Material	Fittings
Main Domestic & softened hot water	All Sizes	Polypropylene PN 20	Electro-fusion Welded

SCHEDULE 3:

4.1 Pipe Supports Spacing – Steel & Copper Pipes

The following table indicates the recommended spacing for pipe supports and guides:

Steel Piping (Temperatures up to 100 °C).

Pipe Size	Distance Between Alignment Guide	Distance between Supports			Hanger Rod Dia
		Horizontal		Vertical	
		Bare	Insulated		in mm
in mm	(meters)	(meters)	(meters)	(meters)	in mm
15	3.0	1.8	1.8	2.4	10
20	3.0	2.4	2.4	2.4	10
25	3.0	2.4	2.4	2.4	10
32	3.0	2.7	2.4	3.0	12
40	3.0	3.0	2.4	3.7	12
50	4.0	3.0	2.7	3.7	12
65	4.6	3.4	2.7	3.7	16
80	5.8	3.7	3.0	4.3	16
100	7.6	4.0	3.0	4.6	16
125	9.0	4.6	3.7	5.5	16
150	10.6	4.9	4.5	5.5	16
200	13.7	5.5	6.0	8.5	16
250	18.0	6.0	6.5	9.0	20
300	21.2	6.4	7.0	10.0	24

For temperatures above 100 °C use rod sizes given in Table (8) of BS 3974.

The following table indicates the recommended spacing for pipe supports and guides:

Copper Piping (Temperatures up to 100 °C).

Pipe Size	Distance Between Alignment Guide	Distance between Supports			Hanger Rod Dia
		Horizontal		Vertical	
		Bare	Insulated		in mm
in mm	(meters)	(meters)	(meters)	(meters)	in mm
15	2.0	1.8	1.8	2.4	10
20	2.0	2.0	2.0	2.4	10
25	3.0	2.0	2.0	2.4	10
32	3.0	2.0	2.0	3.0	12
40	3.0	2.5	2.0	3.7	12
50	4.0	2.5	2.5	3.7	12
65	4.6	3.0	2.5	3.7	16
80	5.8	3.0	3.0	4.3	16
100	7.6	3.0	3.0	4.6	16
125	9.0	3.5	3.5	5.5	16
150	10.6	4.0	4.0	5.5	16
200	13.7	5.0	5.0	8.5	16
250	18.0	6.0	6.0	9.0	20
300	21.2	6.4	7.0	10.0	24

For temperatures above 100 °C use rod sizes given in Table (8) of BS 3974.

SCHEDULE 4:

4.2 Polymer Pipes including:

CPVC , UPVC , ABS, Polypropylene , Polyethylene Pipes

The following table indicates the recommended spacing for pipe supports and guides:

Acrylonitrile Butadiene Styrene (ABS) (Temperatures up to 70 °C).

Max Temp	Distance between Pipe Support In Meters @		
	20 °C	50 °C	70 °C
Pipe Size			
20 mm	1.3	1.0	0.7
25 mm	1.3	1.0	0.7
32 mm	1.3	1.0	0.7
40 mm	1.3	0.9	0.7
50 mm	1.3	1.0	0.7
63 mm	1.4	1.1	0.8
75 mm	1.5	1.2	0.8
90 mm	1.6	1.2	0.9
110 mm	1.8	1.3	1.0
125mm	1.9	1.4	1.0
140 mm	2.0	1.5	1.1
160 mm	2.1	1.6	1.2
200 mm	2.2	1.7	1.3
225 mm	2.3	1.8	1.5
250 mm	2.5	2.0	1.7

General Notes:

Vertical piping should have be supported at each floor and should have a midstory guide, unless thermal expansion design calls for other provisions.

Piping should not be anchored tightly by the support, but secured in a manner to allow for a degree of movement caused by thermal expansion. Hangers or strapping with rough edges should not be used.

SCHEDULE 5:

Schedule of Approved Manufacturers

All materials and equipment specified in this Volume shall be of a quality equivalent to/or better than furnished or manufactured by the following:

Equipment	Manufacturer	Country Of origin
Mild Steel & Galvanized Pipes	Nippon Steel Petros silktube Piatra Econosto	Japan Spain Romania Italy Holland
Grooved Joints	Victaulic Grinnell Surejoint	USA USA Taiwan
Steel Pipe Fittings	Crane Econosto Armstrong AFL	U.K. Holland UK, USA UK, Italy
ABS pipes & Fittings	Durapipe Superflo	UK
CPVC Pipes & Fitting	Fischer Flow Guard NPP	Switzerland Egypt, Taiwan, UAE UAE
PEX AI PEX Pipes & Fitting	Uponor Rehau	Germany Germany
PEX Pipes & Fitting	Wirsbo Rehau LK	Sweden Germany Sweden
Valves	Hattersley Newman Hender Ltd. Crane Oven trop TA Tecofi Econosto	UK UK Germany Sweden France Holland
Refrigerant Pipe insulation	Aeroflex Armaflex Armstrong	UK UK UK
Supports & Hangers	Hilti Fischer	UK Germany

End of section



Section 15410

Drainage System Specifications

Drainage System Specifications

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1. Drainage System

1.1 General specification

This section covers the supply, installation testing and commissioning of sewage, storm water drainage systems and includes internal and external drainage systems in accordance with this specification and the requirements of the local Construction Specifications

1.2 Scope of Works

- A. Furnish , installing, test and commission the complete sewage, waste and storm water drainage systems along with all associated manholes, kerb and duct drains and soak ways as indicated on the Contract Drawings.
- B. The Contractor shall provide all supervision, labour, materials, equipment, machinery and any other items necessary to complete the systems in all respects.
- C. The drainage system shall include the following:
 - 1. Below ground drainage and sewerage system running below grade and between sewage manholes as shown on drawings and specified elsewhere.
 - 2. Above ground soil, waste, vent, drain system as shown on the drawing and specified elsewhere.
 - 3. Kitchen and Laundry waste drainage system, as shown on the drawing and specified.
 - 4. Laboratory waste drainage and venting system, as shown on the drawing and specified.
 - 5. Floor drains, gullies , traps, rodding eyes, overflows, chrome plated bottle traps.
 - 6. Floor gully and rodding eyes covers with strainer.
 - 7. Manholes, ductile covers, gratings, manhole steps as shown on drawings and specified elsewhere.
 - 8. Rain water , surface and storm water pipes complete with cast iron rain water outlets as shown on drawings.
 - 9. Other works and materials to make the system complete and functional.

1.3 Storage and Handling

- A. Storing and handling including taking delivery, loading and unloading of pipes, valves, fittings and other equipment shall be carried out by the Contractor in such a manner as to avoid breakage, distortion, denting or other damage. Stacking of materials shall be done in such a manner as to prevent to the pipe or coatings to the satisfaction of the Engineer.
- B. Plastic pipes and fittings shall be stored under cover and out of direct sunlight at all times. Pipes shall be supported throughout their entire length and free flow of air around them maintained.

Generally, all pipes shall be handled using canvas slings not less than 250mm wide. The use of chains or wire slings will not be permitted.

- C. All valves and fittings shall be stored under cover on hard standing until required for fixing. Uncrated valves and fittings shall not be strapped.
- D. Pipes and fittings damaged during handling or storage shall be set aside and the Engineer informed. If in the Engineer's opinion the damage is such that the pipe or fitting has been permanently impaired it shall be removed from site.
- E. No repairs shall be started without the approval of the Engineer.

1.4 Pipes and Fittings - Materials

1.4.1 General

1.4.2 Above Ground Soil, Waste, Overflow and Venting Systems

- A. All above ground Soil, Waste Overflow, Venting and rain water pipe work, complete with all drains, traps, gullies, cleanouts, vents and all accessories, which run inside buildings and located as follows:-
 - Above floor slab
 - Under tiles
 - Chased In walls and through shafts
 - Ceiling Voids
 - High level and low level (exposed or concealed)
 - All vertical pipes (risers)
- B. UPVC pipes, traps and fittings shall be manufactured under a BS 4514 - EN1329 -1 Quality system and shall comprise the whole range of integrated system of same manufacturer allowing the easy plumbing of an installation.
- C. The system shall comply with appropriate British Standards and where applicable, bear the Kite mark.
- D. Applicable sub-sections Construction Specification shall be applied to all drainage works.
 - A. Reference should be made to the following Codes and Standards:-
 - ▶ BS 3943: 1979 Specification for plastic waste traps
 - ▶ BS 4514: 1983 Un plasticised PVC soil and ventilating above ground EN1329-1:1997
 - ▶ Pipe/ fittings and accessories
 - ▶ BS 5254: 1976 Polypropylene waste pipe and fittings.
 - ▶ BS 5255: 1976 Plastic waste pipe and fittings/50 mm and under.
 - ▶ BS 5572: 1978 Code of Practice for sanitary pipe work (formerly CP 304).
 - ▶ CP312: Part 1 & 2: 1973 Plastic pipe work (Thermoplastic material)

- B. Materials and Colour: pipes and fittings shall be in UPVC in grey or rustic brown.
- C. Socketed fittings shall be solvent-welded with plain-ended pipes. Seal ring expansion joints shall be provided where required.
- D. The system shall be compatible with buried drain system. Weathering Apron (solvent-weld socket) shall be solvent-welded to the soil, waste, vent pipes for weather flashing around pipe at roof.
- E. Seal ring socket type PVC caulking bush shall be used to connect PVC pipes to sockets of other material if applicable.
- F. Adjustable, plastic coated steel holder bats shall be used to support pipes or secure fittings. Galvanised mild steel support bracket with packing piece shall be used for horizontal pipes. Smaller pipes and fittings shall be secured to wall by zinc-plated steel brackets.
- G. Floor drains shall be P- trapped and shall be provided with 200 x 200 nickel coated brass cover including strainer.

1.4.3 Below Ground Drainage and Sewerage System

- A. The below ground drainage and Sewerage shall be of UPVC pipes and fittings and shall comply with BS 4660, 5481– EN-1401-1:1998, and where appropriate shall bear the Kitemark.
- B. Materials and Colours: buried drain system pipes and fittings shall be UPVC with polypropylene seal retaining caps. Underground fittings shall be coloured golden brown. Seal retaining caps and seal rings are black. Rodding eyes shall be provided where required.
- C. UPVC solvent weld socket seal/lip and lip seal/lip seal shall be used.
- D. Where necessary, lip seal/lip seal slip couplings shall be used.
- E. Transition from higher dia. to lower one shall be made by using level invert taper. Special adaptors and caulking bush shall be used to join UPVC channels in manhole connections to drainage system.
- F. UPVC Puddle flanges shall be provided where pipe work passes through the walls or roofs or structural slabs.
- G. Solvent Cements
- H. Solvent cements should comply with either BS 6209 for non-pressure pipe work or BS 4346: Part 3 for pressure pipe work.
- I. Sealing Rings
- A. Sealing rings should be made from natural or synthetic rubber complying with BS2494.

1.5 Manholes

1.5.1 Cement and Concrete

a) Cement

All cement used in all classes of concrete for drainage and sewerage works, whether above or below ground level, shall be sulphate resistant cement, complying with BS 4027

b) Granolithic Concrete

Granolithic Concrete shall be mixed using one part by weight of Portland cement to two parts of clean granite chippings graded as Table 1 of BS 882, to one part of sharp siliceous sand graded as Table 2 and clear water sufficient to form a stiff but workable mix and provide a dense concrete.

c) Cement Mortar

Cement mortar shall consist of sulphate-resisting cement and sand gauged by volume in suitable boxes in the proportions as proposed by BS standards

Unless otherwise specified cement mortar shall be SRC Class No.1.

The ingredients of the mortar shall be mixed in an approved mechanical mixer or shall be mixed together dry on a clean wooden stage until the mix is homogeneous in colour. Water shall then be added through a rose in sufficient quantity to give no more than stiff workability. The Whole shall then be turned until perfectly mixed.

Mortar shall be used within 30 minutes of mixing and shall not be remixed or worked up again after it has stiffened. Any mortar that has commenced to set shall be removed from the works.

Concrete Classification

CONCRETE GRADE	CHARACTERISTIC STRENGTH N/mm ²	APPLICATION
SRC 30	30	Precast Concrete
SRC 25	25	Normal reinforced concrete, blinding thrust blocks
SRC 25	25	Mass concrete hard standings
SRC 20	20	Mass concrete, pipeline protection and surrounds protection to tanking and hollowing block infill.
MIX PROPORTION FOR CEMENT MORTAR		
PROPORTION BY VOLUME FOR CEMENT		
Cement	Sulphate Resisting	Sand Lime
No. 1.	1	2 -
No. 2.	1	3 -
No. 3.	1	5 1

vi) RENDERING TO MANHOLE BEDDING

- ▶ Rendering to manhole benching shall comprise a 12mm thick layer of approved epoxy mortar.

1.5.2 Manholes Generally
1.5.2.1 General

Manholes shall be provided at all changes in direction, gradient or diameter.

The manholes shall be of the sizes and grades indicated on the Contract drawings and fully comply with MOPW regulations and Construction Specification

1.5.2.2 Block work Manholes

Block work manholes shall be constructed on the drain lines in the positions and to the dimensions indicated on Drawings or as directed on site by the Engineer.

The type of construction for each chamber shall be as indicated on the Contract Drawings.

Concrete blocks used for chamber construction shall be manufactured with sulphate resisting cement and shall comply with the requirements of MOPW Construction Specification

Hollow concrete blocks shall be filled solid with concrete Grade SRC 20.

Each manhole shall be built on a minimum of 75mm thick blinding of grade SRC 25 concrete which shall be laid on a dry clean firm foundation free from unsold material. If the bed of the excavation is wet, the top surface of the blinding shall be coated with an approved waterproofing material.

Foundation base slabs shall be cast in-situ. Mass concrete foundation slabs shall be of concrete Grade 20. Reinforced concrete foundation slabs shall be of Grade SRC 30.

Internal and external faces of the block work walls shall be finished with 12mm thick SRC mortar rendering Class 1.

All internal faces of manhole chambers except benching and vitrified clay channel fittings shall be painted with one primer coat and two final coats of black bitumen coating water proofing solution to BS 3416, type 1 or equal and approved.

All exterior faces of manhole chambers shall be protected with 1000-gauge polythene membrane with hardboard protection against damage during backfilling.

Where indicated on the Drainage, manhole cover frames shall be supported on solid precast concrete bricks, manufactured from Grade SRC 30 concrete.

Reinforced cover slabs shall be provided where manhole access openings are less than the internal dimensions of the manhole chamber.

The cover slabs shall be mounted by ductile manhole covers and frames of the quality specified. The covers in roads and paved areas

shall be accurately set on precast concrete brickwork to the level and slopes of the roads or pavements.

Manhole inverts shall be constructed of half section vitrified clay channels. Half section vitrified clay channel branch bends shall be used for branch connections. Benching in manholes shall be carefully formed according to the number, diameter and positions of the incoming and outgoing pipes. The benching in the manholes shall have vertical sides extending from the vitrified clay channels at least to the level of the crown of the highest pipe. The benching shall be sloped towards the channels at gradient of 1 in 10 or as otherwise detailed on the drawings. The benching shall be rendered with a 12mm thickness of epoxy mortar rendering. The ends of all pipes entering and leaving the manhole are to carefully cut to shape to suit the internal dimensions of the manholes, and shall project through on the inside, the benching being

Continued round the pipe to form a fillet.

1.5.2.3 Precast Concrete Manholes

The base shall be cast in-situ and shall be Grade SRC 20 concrete to the dimensions shown on the drawings.

The whole base including the outside surround to the pipes shall be cast monolithic. Immediately before concreting, lengths of pipes to be built in shall be surrounded with a layer of cement mortar No. 1.

All chamber and shaft rings of the manholes shall comprise precast Grade SRC 30 concrete units as shown on the drawings.

The formwork for all precast concrete rings shall be purpose made in mild steel and shall incorporate surface vibrators of adequate performance to ensure proper compaction of the concrete. The forms must have provisions for allowing the casting in of the step irons. All precast components for manholes shall be

made in accordance with BS 5911 or equivalent approved standard. Precast concrete components shall immediately after the removal of forms, be sprayed with an approved curing membrane. Regular spraying with water will not be an acceptable method of curing.

Where the Contractor does not own forms with surface vibrators for the production of precast concrete manhole components he may, with the written approval of the Engineer employ an approved method of hand compaction. If the Engineer gives such written approval, this does not imply acceptance of the quality of the finished work.

The positions of lifting holes or eyes in precast components are to be approved by the Engineer. Lifting holes are to be grouted up after construction of the manhole.

1.5.2.4 Step Irons

Step irons are to be positioned in the chamber shaft rings in such manner that the step irons are vertically linear. The joints at each step iron shall be made water-tight and strong, free from any crack and if found otherwise the Engineer may reject the precast ring or may instruct the Contractor to take any necessary measures to make the ring watertight.

The first step iron shall be fixed at a maximum of 600mm below the cover level and the last step iron shall be fixed at a maximum of 300mm from the top level of the lowest adjacent benching.

Step irons shall be staggered at 300mm centres vertically and horizontally.

All joints between rings or slabs shall be made watertight to the satisfaction of the Engineer with a bituminous mastic strip sealant as approved. The external face of the joint is to be sealed with epoxy mortar.

A 150mm thick in-situ Grade SRC 20 concrete surround shall be placed around the manhole as shown on the Drawings.

1.5.2.5 Chamber Rings

Chamber rings shall be manufactured from concrete Grade SRC 30.

Both internal and external surfaces of the chamber rings shall be coated with a solution of bitumen refined from asphaltic crude oil, the solution having total solids content of approximately 45% and a viscosity corresponding to a No. 4 for cup time of approximately 30 seconds.

1.5.2.6 Manhole Covers and Frames

Manhole covers and frames shall ductile cover comply with BS 497:1976 and shall be of the sizes and types as shown on the Contract Drawings.

In general, manhole covers and frames shall be one of three types, as follows, unless otherwise specified.

- ▶ Heavy Duty, to BS 497 Grade A
- ▶ Medium Duty, to BS 497 Grade B1
- ▶ Light Duty, to BS 497 Grade C

1.5.2.7 Heavy Duty

All manholes installed in roadways or trafficked areas shall be heavy duty Ductile cover to BS 497 Grade A, Reference MA 60.

The cover and frame shall be made from ductile iron and the cover shall be of the loosely bolted double triangular type with three-point suspension to provide stability under load.

1.5.2.8 Medium Duty

All manholes installed external to buildings, but not in roadways or trafficked areas, shall be medium duty to BS 497 Grade B1.

The cover and frame shall be of ductile iron and the cover shall be either rectangular or circular as specified in the Manhole Schedule. Such manholes shall incorporate a single seal between cover and frame. Following flushing out and testing of the drainage system, the sealing groove shall be filled with grease to provide an airtight seal.

1.5.2.9 Light Duty

All manholes installed within buildings and not subject to motor vehicles or industrial trolleys etc. shall be light duty to BS 497 Grade C of the lockable type.

The cover and frame shall be made from grey iron and shall incorporate a double seal between cover and frame. Following flushing out and testing of the drainage system, the sealing grooves shall be filled with grease to provide an airtight seal.

In those areas where it is required to accept a tiled floor finish, the manhole covers shall be of the recessed type. In kitchens, or other areas subject to washing down, manhole covers and frames shall have stainless steel edging and trim. Double-cover units shall be provided where specified in the Manhole schedule.

The Contractor shall provide two sets of lifting keys for each type of manhole.

Manhole covers and frames shall be as approved.

1.5.2.10 Recessed Covers

Where manholes installed within tiling or decorative floor finish surroundings, a recessed type manhole covers shall be installed.

The cover and frame shall be made from galvanized steel cover and frame and shall incorporate a double seal between cover and frame. Manhole covers shall be fastened to frames by heavy-duty counter sunk screws. Floor finishing shall be rendered continuously within the manhole covers to match the surroundings.

Following flushing out and testing of the drainage system, the sealing grooves shall be filled with neoprene to provide an airtight seal.

In kitchens, or other areas to washing down, manhole covers and frames shall have stainless steel edging and trim. Double-cover units shall be provided where specified in the Manhole schedule.

The Contractor shall provide two sets of lifting keys for each type of manhole.

Manhole covers and frames shall be as approved.

1.6 Floor Drain

1.6.1 Floor Drain Type (FD-1)

Floor drains (local made) and removable waste trap with protective plug, And ABS grate and cover top 100x100mm.

1.7 Storm Water System

1.7.1 Pipe work and Fittings

Pipe work and fittings for storm water system shall be UPVC to B.S. 4514 –EN-1329-1. All pipe work, fittings and accessories shall be installed strictly in accordance with manufacture's recommendations. The Contractor shall ensure that the UPVC used is of a sufficiently high temperature rating to withstand the environmental conditions.

1.7.2 Rain Water outlets (RW01)

UPVC roof drain, of a 100 mm socket outlet complete with removable circular grating screw and polypropylene washers and screw fixed to roof slabs. The outlet shall be fitted with P-trap for sediment cleaning and foul air trapping.

1.7.3 Pipe work Installations

- A. During installations of the storm water system, the Contractor shall make due allowance for the expansion of the pipe work and fittings during normal working conditions. Further allowance shall be made for solvent weld joining of the above materials with regard to temperature and humidity.
- B. The bores of all pipe work shall be smooth and free from all burns or obstructions; bends wherever possible shall be of the long radius types.
- C. All connections between pipes and Rainwater outlets shall be made with approved connectors.

1.7.4 External Storm Water

- A. The external storm water system consists of underground pipes connected to the soakaway or as indicated on drawings, complete system comprising soakaway, gullies and interconnected pipe work.
- B. Pipe work and fittings used in the external work installation are to be of UPVC to BS. 4514. - EN1329
- C. The bore of the pipe work shall be clear of all obstructions.
- D. The Contractor shall ensure that during backfilling of the excavations required to install the external storm water no damage is caused to this installation.
- E. The pipes and fittings shall be laid on a 150 mm thick granular bed of broken stone rock or gravel retained on a 5 mm sieve and passing through a 15 mm sieve. The bed shall be properly

compacted and graded to support the barrel of the pipe to the correct level and fall prior to laying the pipe.

- F. Cover the pipe to a depth of 150 mm to above the top of the pipe with the same granular material carefully compacted by hand. Fill above this point with selected excavated materials free from large objects or builder's debris carefully compacted in 150 mm thick layers.
- G. Pipe work passing through the walls or foundations shall be sleeved with PVC pipe of sufficient size to allow clearance round the drainpipe. The gap between the drainpipe and sleeves shall be caulked with mastic.
- H. Where pipes pass through or below foundations, flexible couplings shall be provided not closer than 150 mm or more than 300 mm from the face of the building.
- I. The whole of the external storm water installation shall be tested in accordance with the requirement of B.S. 5572 - 1978; this shall be to the complete satisfaction of the Engineer.

1.7.5 Protection of Works

The installation shall be adequately protected against damage and deterioration when handed over, the installation shall be in a clean and sound condition. Particular care must be taken during the course of construction to seal all open ends of pipe work, gullies and soak away with a temporary cover. Wood shavings or paper will not be accepted for this purpose.

1.7.6 Painting

- A. The Contractor shall clean and paint all brackets and supports with two coats of red oxide paint.
- B. Exposed pipes in the Kitchen, Bathroom etc. Shall be painted with matching colour of the wall to the satisfaction of the Engineer.

1.8 Testing and Commissioning

1.8.1 General

- A. All drainpipes shall be tested in accordance with the requirements of BS 8301 and the requirements of the local authorities having jurisdictions.
- B. The Engineer shall witness all drainage tests. The Contractor shall give the Engineer a minimum of 24 hours notice of all tests. The Contractor shall also provide test sheets set out in an agreed manner for each drain section to be tested.
- C. The Contractor having ensured that water, electricity and other necessary supplies are available shall set to work the completed works or part thereof, at the instruction of the Engineer, and make the necessary adjustments to ensure correct functioning.
- D. After the installation or part thereof has been set to work and adjusted, the Contractor shall demonstrate its operation at a time selected by and to the satisfaction of the Engineer. Tests shall be in accordance with British Standards BS 6700: 1987.
- E. The test shall demonstrate: -

- a. That equipment provided complies with the Specification in all particulars and is of adequate capacity for its full rates of duty.
 - b. That all items of plant and equipment operate quite sufficiently to meet the specified requirements.
 - c. That all instruments, protection and control devices, etc., are correctly calibrated and accurate.
 - d. That all drainage runs satisfy the required water tests.
- F. The details of method of carrying out the recording of tests shall be agreed with the Engineer. The Client's representative and the Engineer shall be at liberty to be present at tests and to participate in the tests. This shall not relieve the Contractor of his responsibilities for carrying out the tests satisfactorily.
- G. The Contractor shall make all the records during the tests and on completion thereof shall provide the Engineer with a test report and record, both in triplicate. The Contractor shall also provide all test instruments together with skilled supervision and adequate labour for carrying out the tests.

1.8.2 Proving Tests

- a- All under slab, underground drainage, soil and waste system shall be cleaned down and thoroughly flushed out to remove all dirt within each pipe work system.
- b- After each system has been flushed and each draw off fitting opened and the drainage soil and waste system shall be checked for satisfactory rate flow. And tested by profile test
- c- Particular attention shall be given to groups of sanitary fittings to ensure satisfactory flow when a number of fittings are flushed and air not drawn into the system via any trap.

1.8.3 Water Test

- A. All drains shall be tested before backfilling, immediately after the drain has been properly laid on the correct trench bed and after joining materials has had time to set. A water test pressure of 1.3m head above the soffit of the drain shall be applied at the high end, but not more than 2.4m head at the low end. The test shall be carried out on lengths of drain not less than half the distance between manholes, all to be agreed with the Engineer on site. The lower end of the drain shall be plugged and the higher end shall have a standpipe not less than 1.2m high. The drain shall be filled, taking care to eliminate trapped air. After repair of leakage due to defective pipes, joints and plugs, the drain under test shall be left for one hour to allow water absorption by pipe and fittings.
- B. The loss of water over a period measuring vessel at intervals of ten minutes and noting the quantity of water required maintaining the original level in the standpipe. For drains up to 300mm diameter, the water quantity added shall not exceed 0.06 litre per hour per 100 linear metres per millimetre of nominal bore of the drain under test.
- C. All drains shall be tested for a second time as described above after correct bedding cover and selected backfill have been consolidated and the finished surface complete.

1.8.4 Air Test

- A. A gauge in the form of a "U" tube shall be connected to the plug fixed at one end of the length to be tested and all junctions and connections to the sewer or drain shall be plugged. Air shall then be pumped in from the other end of the drain under test until a pressure equal to 100mm of water is indicated on the gauge. Without further pumping, the pressure shall not fall more than 25mm during a period of five minutes.
- B. Air tests shall be carried out after 3 pm and all pipe work shall be shaded from the sun at all times. Should an air test fail, a water test shall be carried out as described in this Specification.

1.8.5 Testing and Commissioning for Drain Pipes

- A. The Contractor shall provide all equipment necessary for testing. Generally, the whole installation shall be tested in accordance with the requirements of the MOPW
- B. Before any test is carried out the Engineer shall be given 24 hours notice. All defects located shall be corrected before further work proceeds and the whole of the section of work affected shall be re-tested.

No section of pipes shall be back-filled before it has been tested.

1.8.6 Test for Storm Water

- A. Testing shall be carried out before any pipes are hunched or surrounded with concrete. All joints shall be exposed.
- B. Storm water should be tested in section. Short branches connected to main runs shall be tested at the same time.
- C. The length to be tested shall be subjected to a static head pressure of not less than 1.5 M at the highest point of the section being tested. After sufficient length of time has been allowed for, the absorption of water into joints, the section under test shall be 'topped-up' and the head maintained without apparent loss for not less than one hour.

1.8.7 Profile Test

- A. A hardwood ball, of an approved profile, shall be drawn through all foul drains from manhole to manhole and through branch foul drains before soil pipes, gullies and W.C.'s are filled. The diameter of the ball or profile shall differ from the nominal internal diameter of the pipe by not more than 6mm or by not more than 4% of the nominal internal diameter of the pipe, whichever is the greater difference.
- B. During commissioning, all manhole cover shall be removed and water flow tests shall be carried out to ensure that the drains are flowing at their designed capacity and that they are free of debris.

1.8.8 Manhole Test

- A. All manholes shall be tested in accordance with the requirements of BS 8301 and the requirements of the local authorities having the jurisdictions.

-
- B. The Engineer shall witness all manhole tests. The Contractor shall give the Engineer a minimum of 24 hours notice of all tests. The Contract shall also provide test sheets set out in an agreed manner for each manhole to be tested.
 - C. All concrete manhole cast in situ and precast concrete manholes shall be water tested by plugging all necessary connections and filling the manholes with water to a minimum height of 600mm above the top of the benching. Water shall be added at ten-minute intervals until absorption has ceased. No change of water level shall occur for an uninterrupted period of three hours.

1.9 SCHEDULE 1:**Schedule of Plumbing Systems Approved Manufacturers**

Equipment	Manufacturer	Country Of origin
UPVC Pipes & Fittings	Terrain	U.K.
	SAPCO	KSA
	Marley Extrusion Ltd.	U.K.
	Hepworth	UK,UAE, Qatar
	NIC	Kuwait

End of section



Section 15650

HVAC Refrigeration Specifications



HVAC Refrigeration Specifications

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1. HVAC Refrigeration Systems

1.1 Equipment

1.1.1 Split DX Heat Pump Units

A. General:

Provide factory-assembled and tested split D/X units as indicated, designed for roof, slab or floor mounting consisting of compressors, condensers, evaporator fans, refrigeration and temperature control, filters,. Provide capacity and electrical characteristics as scheduled.

B. Evaporator Fans:

Provide tangential , centrifugal, and permanently lubricated motor bearings.

C. Condenser Fans:

Provide propeller-type, direct-driven fans with permanently lubricated bearings.

D. Coils:

For evaporator and condenser, provide non-ferrous construction with aluminum plate fins mechanically bonded to seamless copper tubes; with brazed tubing joints. Circuit evaporator to provide full active face on minimum cooling step.

E. Compressors:

Provide reverse cycled scroll/reciprocating compressors type. Provide vibration isolators,

Provide thermal expansion valves, and provide minimum. Provide fan-cycling control for low ambient control to 45°F (7°C).

F. Safety Controls :

Provide the following controls:

1. Low pressure cutout, manual reset.
2. High pressure cutout, manual reset.

G. Refrigerant Piping and Fittings

Refrigerant pipes installed in the field shall consist of insulated copper tubing and recessed solder joint fittings. Tubing shall be in accordance with ASTM Specification B 88-61 type 'k' hard drawn. fittings shall be wrought copper or tinned cast brass. where required for connection to gauges and control devices, tubing not larger than 3/8 inch. O.D. may be type 'k' soft (annealed) with flared tube or double ferrule compression fittings suitable for high pressure. On all joints in refrigeration piping flux and solder which is recommended by solder type fittings manufacturer shall be used. Tubing shall be protected against oxidation during silver soldering by use of dry nitrogen flowing through the tubing.

Accessories for field assembled refrigerant piping systems such as oil separators, liquid receivers, heat exchangers, dryers, expansion valves, refrigerant strainers, sight glass etc., shall be in accordance with instructions of the units manufacturers standard practice and specific recommendations.

Drain line shall be of UPVC pipe –16 bar fitted with dielectric fitting to drain pan.

H. Filters:

Provide filter section consisting of 2" thick fiberglass throwaway filters in filter rack, with maximum face velocity of 300 fpm.

I. Automatic Temperature Control System

Provide combination thermostat and fan switches to control the room temperature automatically, provide factory fabricated unit of the same manufacturer of DX-\ having sensor,

J. Electrical:

Provide 220-400V convenience outlet, separately fused, with relay, contactors, indicator lamps, overload switches for unit service. Provide means for unit power connection through unit cabinet.

K. Accessories :

Provide the following accessories;

L. Time Guard:

Provide time guards to prevent short cycling of compressors.

Examine areas and conditions under which split D/X cooling units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

M. Installation of Split D/X Cooling Units

1. General: Install split D/X cooling units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in approved locations, and maintain manufacturer's recommended clearances.

2. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal.

N. Start - Up

1. Start-up split D/X cooling units, in accordance with manufacturer's start-up instructions. test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

2. Balance split D/X unit systems to verify its capacity and balanced delivery of air for each space.

O. Grounding

Provide positive equipment ground for split D/X cooling unit components.

1.2 SCHEDULE:

Schedule of Approved Manufacturers

All materials and equipment specified in this Volume shall be of a quality equivalent to/or better than furnished or manufactured by the following

Equipment	Manufacturer	Country Of origin
Split Units	Daikin/Mcquay	Japan, Europe
	Mitsubishi	Japan
	Toshiba	Japan, Europe
	Fujitsu	Japan
	O' General	Japan
	Trane	USA, France, UK
	SKM	UAE
	Petra	Jordan
Samsung	Korea	

NOTES

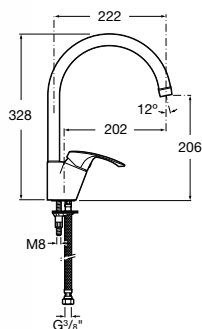
- 1 The design is based upon the equipment listed in the equipment.
- 2 The tender pricing shall be based on any of the above listed acceptable manufacturers for each type.
- 3 The contractor must submit the base tender complying with the listed manufacturer's equipment. An alternative offer from alternative manufacturers may be submitted in addition to the base tender, provided that full substantiating data of the equipment, and noting the non-compliant features of the alternative equipment together with the cost implications, is submitted. All alternative equipment offers may be accepted or rejected at the sole discretion of the Engineer as it shall be to the approval and final acceptance of the Engineer .
- 4 Submit the compliance form with the Tender indicating the proposed manufacturers for major equipment. Treat all equipment for which data submissions are required as major equipment for this purpose.
- 5 Changes from the equipment offered at Tender will not normally be permitted unless the Engineer is satisfied that there is significant advantage in Principle.

End of section

ROCA Preparation Areas : Faucet

Monodin | Cartucho cerámico / Ceramic cartridge /
Cartouche céramique / Cartucho cerámico

Griferías para cocina Kitchen mixers Robinetterie pour cuisine Torneira para cozinha



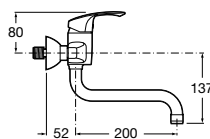
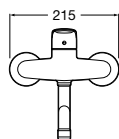
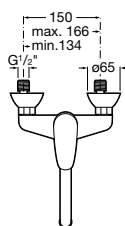
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Mezclador para fregadero con caño alto giratorio, aireador y enlaces de alimentación flexibles

Sink mixer with high swivel spout, aerator and flexible supply hoses.

Mitigeur pour évier avec bec haut tournant, aérateur et raccords d'alimentation flexibles

Misturadora para lava-louça com cano alto giratório, prelator e ligações de alimentação flexíveis.



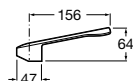
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Mezclador para fregadero con caño inferior giratorio, aireador y enlaces alimentación flexibles

Sink mixer with high swivel spout, aerator and flexible supply hoses.

Mitigeur pour évier avec bec haut tournant, aérateur et raccords d'alimentation flexibles

Misturadora para lava-louça com cano alto giratório, prelator e ligações de alimentação flexíveis.



525003000

Manecilla gerontológica. Compatible con todas las griferías de la serie.

Elbow handle. Compatible with all the faucets in the series.

Poignée gérontologique et hospitalière. Compatible avec toutes les robinetteries de la série.

Manipulo hospitalar. Compatível com todas as torneiras da série.

Serie U-top

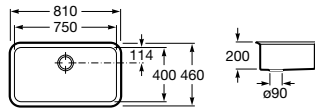
Fregaderos de acero inoxidable. 18/10 Cromo-Níquel de 1 mm de espesor. Para instalación en encimeras de 600 mm de fondo. Instalación enrasada con encimera. Se suministran con el conjunto de válvulas 3 1/2" (tapón cestillo) con desagües. Sin orificios de grifería practicados. Todos los modelos se suministran con desagüe automático de serie.

Stainless steel sinks. 18/10 Chrome-Nickel, 1 mm thick. For flush-fitting to worktops of 600 mm depth. Supplied with the 3 1/2" valve set (basket plug) with overflows. No faucet holes. All models are supplied with automatic overflow as standard.

Éviers en acier inoxydable. 18/10 Chrome-Nickel de 1 mm d'épaisseur. Pour encastrer sur plan de travail de 600 mm de large. À encastrer sur plan de travail. Ensemble bonde Ø90 (bouchon et panier) et siphon. Livré sans orifice de robinetterie. Tous les modèles sont munis d'un vidage automatique de série.

Lava-louças de aço inoxidável. 18/10 Cromo-Níquel de 1 mm de espessura. Para instalação em tampo de 600 mm de profundidade. Instalação nivelada com tampo. Fornecidos com o conjunto de válvulas 3 1/2" (tampão cesto) com válvulas de descarga. Sem orifícios de torneira praticados. Todos os modelos fornecidos com válvula de descarga automática de série.

U-top 81



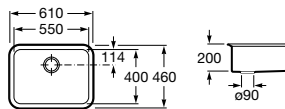
876810815 810 x 460

Cubeta con válvula 3 1/2" *Basin with 3 1/2" valve*

Bassin, bonde Ø90

Cuba com válvula 3 1/2"

U-top 61



876810615 610 x 460

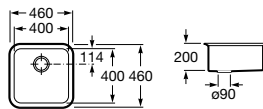
Cubeta con válvula 3 1/2" *Basin with 3 1/2" valve*

Bassin, bonde Ø90

Cuba com válvula 3 1/2"

ROCA Common Preparation Area: Sink

U-top 46



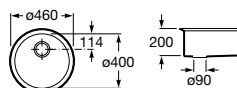
876810465 460 x 460

Cubeta con válvula 3 1/2" *Basin with 3 1/2" valve*

Bassin, bonde Ø90

Cuba com válvula 3 1/2"

U-top 46R



876890465 Ø 460

Cubeta con válvula 3 1/2" *Basin with 3 1/2" valve*

Bassin, bonde Ø90

Cuba com válvula 3 1/2"

Petra Gate

DIVISION 16

ELECTRICAL WORKS

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SECTION 1600-100

GENERAL PROVISIONS FOR ELECTRICAL INSTALLATION

GENERAL PROVISIONS FOR ELECTRICAL INSTALLATION

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GENERAL PROVISIONS FOR ELECTRICAL INSTALLATION

100.1.1 Definitions

The following terms and abbreviations used in these specifications / drawings shall mean:

Contractor:	The Elector-mechanical Contractor
EDCO:	Electricity distribution company, Jordan.
JTC	Jordan Telecommunications Corporation, Jordan.
MOPW&H Regulations:	Regulations issued by the Ministry of public works and housing, Amman-Jordan, regarding the installation of electrical systems (latest edition)
CDD:	Civil defence department, Amman-Jordan.
IEE Regulations:	Regulations for the installation of electrical equipments in buildings as stipulated by the Institution of Electrical Engineers. B.S.S or B.S.C.P :British Standards Specifications or British Standard Codes of Practice.
Contract Drawings:	Copies of the drawings on which the tender is based and scheduled therein.
Shop Drawings:	The detailed drawings prepared by the Contractor for the purpose of execution of the work at site.
As-Built Drawings :	The final drawings prepared by the Contractor Which is the true record of the actual work carried out on site. Works to include the provision of all equipment and materials for all works to be carried out by the Contractor in accordance with the specifications and drawings for the satisfactory completion and operation of the installation.
Site :	The location where the works are to be carried out.
The Engineer:	The technical representative of the client assigned to supervise the works.
Short circuit capacity;	The short circuit capacity (Isc) mentioned on this specifications and/or drawings correlate to the ultimate breaking capacity. i.e ultimate breaking capacity equal rated service capacity (Icu= Icn).
Mains Supply Failure:	The mains supply failure initiated when one of the following conditions exists for more than 3 seconds (failure of one or more phase OR line voltage outside nominal voltage by $\pm 15\%$ or more)

100.1.2 General Provisions

It is understood and agreed that the Contractor, has by careful examination of the plans and Specifications, and the site where appropriate, satisfied himself as to the nature and location of the works, and all conditions that must be met in order to carry out the works under this section of the Contract.

100.1.3 Pre-tender Requirements

100.1.3.1 Familiarisation

The contractor shall visit the site, Acquaint himself to the existing site conditions in-order to familiarize with the status of the existing equipment and installations.

The contractor shall review all Contract documents, and the documents for other trades, highlight and raise queries to the Consultant for any possible ambiguities as is necessary to accurately price the work. No item which could reasonably have been clarified in this manner will later form the basis of a variation to the Contract.

The contractor shall review all contract documents, and the documents for other trades, ask questions from the Consultant and visit the site as is necessary to accurately price the work. No item which could reasonably have been clarified in this manner will later form the basis of a variation to the Contract.

100.1.3.2 Clarification

If interpretation of the Tender Documents is unclear obtain clarification from the Engineer. If clarification is not obtained prior to close of Tenders, the item or arrangement of better quality, greater quantity, or higher cost shall be deemed to be included.

100.1.3.3 Interpretation

The tender documents are intended to be complimentary and where any items are repeated it is intended to call particular attention to them or to qualify them; it is not intended that any other part shall be assumed to be omitted if not repeated. Items may be covered in the specifications or the drawings or both.

If interpretation of the Contract Documents is unclear, obtain clarification from the Engineer. Documents of later date will govern over documents of earlier date. All documents in any set (e.g. Tender Set) will be deemed to be of the date of issue of that set for purposes of establishing precedence.

Within any set, the particular will govern over the general as in the following examples:

- Specific details will govern over general layout.

Specific requirements for a piece of equipment will govern over general requirements for a type of equipment.

100.1.3.4 Complete & Finished Work

Complete and commission all work within the Contract.

Provide any incidental materials, components or service, which may be necessary to make the work complete in all respects and ready for operation. All such materials and components shall conform to the same standard and be of the same make as similar items specified herein.

100.1.3.5 Construction Loads

Ensure that movement and installation of equipment and materials under this Contract does not impose loads on the building which are either unsafe or likely to damage any part of the building.

100.1.3.6 Fixings

Wooden, plastic or fibre plugs will not be permitted as fixings into concrete, masonry and similar construction. Fixings shall be approved metal expansion devices such as Loxen , Hilti or other approved manufacture, installed in strict accordance with the manufacturer's recommendation.

Hangers and fixings connected to any metal *structure* shall be of Caddy manufacture or equal approved.

100.1.4 Permits, Fees & Authorities

100.1.4.1 Permits and Fees

Give all necessary notices, obtain all permits, perform all tests and pay all fees and other costs in connection with the work. File all necessary plans and obtain all necessary approvals from the statutory authorities having jurisdiction over the work.

100.1.5 Changes And Variations

Changes resulting from the detailed co-ordination and layout of equipment and services by the Contractor shall not be the basis of a variation to the contract. Offsets of cable trays, trunking, etc resulting from the Contractor's co-ordination of equipment, services and structure shall not constitute a variation. Contractor shall allow for relocating light points, Fire alarm points, speaker points, Telephone, T.V and security points within a radius of 1 meter from the location shown in the approved shop drawings.

Provision of equipment other than the design base shall not lead to a variation. The Contractor shall be responsible for costs to other trades resulting from provision of such equipment.

100.1.6 Tender Drawings

Tender drawings show general arrangement but are not fully dimensioned and are in places drawn for clarity of intent rather than dimensional accuracy. Information will not necessarily be shown in both the Specifications and Drawings. Any items shown in one or the other forms part of this contract. Do not scale the tender drawings. Verify all dimensions from the architectural drawings and by site measurement. Obtain formal approval from the Consultant before making any fundamental changes from the conceptual layout.

100.1.7 Coordination with Other Trades

Co-ordinate the layout with the Main Contractor and all other trades, and if so directed by The Engineer, prepare composite working drawings and sections at 1:50 and 1:20 scale clearly showing how his work is to be installed in relation to the work of other trades. Set out all equipment and services to suit actual space conditions.

Locate all equipment for convenient operation, maintenance and future replacement.

100.1.8 Shop Drawings and Technical Data

No alteration to the drawings shall be carried out without the consent of The Engineer, after the shop drawings have been approved. Approved changes if any, shall be supported by sketches and incorporated in the "As-built" drawings.

Prepare dimensioned shop drawings for the following sections of the installation to a standard at least equal to the tender drawings.

- Floor plans 1:100

- Plant room Layouts (minimum 1:50)
- Main Switch boards, Sub-main Switch boards and distribution boards diagrams
- Manufacturer's working drawings for all specialized items of equipment such as Main switch board Sub main boards , Distribution Boards and control panels.

Actual conduit routes with circular junction boxes indicating the size of conduit, number and size of wires it is carrying, where it is rising up or bending down etc.

Separate drawings shall be prepared for each level of conduit run.

Mounting arrangement of light fittings, cables, cable trays, trunking etc.

Sectional views for co-ordinating the electrical wiring and other services like Air-conditioning, Drainage and Plumbing.

Main switch boards, sub-main switch boards and distribution boards details.

DB schedules which when read in conjunction with the Lighting & power layout details the function of each board.

Any sections of the installation requiring detailed spatial co-ordination with other trades.

Any section of the work containing equipment differing from the design base in dimension or in Configuration.

All shop drawings shall be submitted initially as two (2) prints for checking and stamping for issue.

The purpose of this review is to minimise the likelihood of inconvenience to the Engineer which would result from rejection of unsatisfactory equipment or work following installation.

The review is in no way intended to relieve the Contractor's responsibility to check the shop drawings and technical data and to meet the contract requirements especially where some items have been missed out or substituted. In this instance, the Contractor shall be responsible for installing the original items specified.

It is the Contractor's responsibility to ensure that equipment offered are compatible. Generally, checking of technical data by the consultant should be considered for information purposes only and final lengths, sizes, ratings and any critical factors are the Contractor's responsibility.

Sign all shop drawings and technical data to certify that they have been checked in detail, are fully understood, meet the specification and are considered suitable for the purpose intended. Draw any specific areas of doubt to the Consultant's attention for resolution.

Submit all shop drawings and technical data in accordance with the construction programme and sufficiently in advance of building work to allow sufficient time for checking and possible amendment and re-submission.

100.1.9 Spare Parts

The Contractor shall supply a complete set of recommended spare parts for all equipments for satisfactory operation of the Electrical system during the defects liability period, 5% spares of all types of MCCBS, MCBs, contactors, contactor coils, light fittings, lamps and control gears shall be handed over to the owner at the end of commissioning and hand over of the Electrical system.

100.1.10 Preventative Maintenance

Maintain all systems and equipment installed under this Contract in accordance with the manufacturers recommendations, the maintenance manual and this specification. The maintenance period starts when the equipment arrives on site and ends 400 days after Practical Completion of the building as a whole. Carry out maintenance of each component at least as frequently as recommended by the Manufacturer. Record and submit details of maintenance in a format acceptable to the Engineer at the end of the maintenance period.

100.1.11 Particular Requirements

100.1.12 Scope of Works

The work to be carried out under this contract shall comprise the supply, connection, testing, commissioning and setting to work of all items that are necessary for a complete working electrical installation, as per specifications drafted in these sections, and drawings referred in the schedule of drawings and as described elsewhere in the specification/contract documents.

The Contractor shall include in his tender for all installations, materials and equipment required to provide a complete installation, whether specifically mentioned in the drawings and particular specifications or not.

The Contractor shall provide a complete electrical installations and also include other associated works such as supporting structures, ancillary works etc.

The work shall comprise, but not be limited to:

Supply and installation of incoming supplies to main switch boards.

Supply and installation of main switchboards to receive the Electrical Supply

Supply and installation of mains and sub-main feeders on cable trays and / or installed in trenches from the main switchboard to sub main switch boards, distribution boards, isolators, equipment etc.

Supply and installation of sub-main boards, distribution boards, ELCB's, isolators etc.

Supply & Installation of all light fittings, complete with lamp and all associated sub-circuits, conduits, switches etc.

Supply and installation of all socket outlets, switch plugs, permanent connection and the like and including all associated sub-circuits, conduits etc.

Supply & Installation of Emergency and Exit Lighting.

Supply and installation of all cables, cable trays, conduits and/or trunking, junction boxes, patch panels, outlets, etc...associated with telephone and data systems.

Empty conduit Installation for CCTV system including power supply and Provision to interface with other services as shown on drawings.

Supply and Installation of stand-by power generators and its associated automatic transfer switches

Supply and installation of a complete earthing and equipotential system.

Empty conduits installations for fire detection and alarm system

Preparation of shop drawings and "As Built" drawings all as specified

Preparation and submission of Operation and Maintenance manuals.

Instruction of the Client's maintenance personnel in the operation and maintenance of all building services.

Testing and demonstrating the performance of all systems.

All associated builder work including cutting, chasing, penetrations, making good etc.

Anything that has been omitted in any item of works and materials usually furnished which are necessary for the completion of Electrical works as outlined here in before, then such items must be and are hereby included in the section of work.

100.1.12.1 Other Associated Works

The following works associated with the work covered by this portion of the Contract shall also be carried out by the Contractor and required allowances should be made by the Contractor for the same. The scheduled quantities are not intended to be a full specification of items to be provided. They are provisional only and indicate the general extent of works.

100.1.12.2 Associated Construction Work

Provision of all penetrations through building structural elements.

Making good of all chases and penetrations after the installation of the electrical services

Openings for all recessed light fittings

Set out lines of doors, walls columns etc to enable accurate location of the services installation

Provisions of switch room, electrical rooms, cupboards and the like to accommodate main switchboard, distribution boards, communication junction boxes etc.

Provisions of all signage to all switch room and riser cupboard doors.

100.1.12.3 Associated Mechanical Services Work

Supply and installation of all electrical works associated with air conditioning and ventilation services including individual isolators for AHUs, chilled water pumps, fans and all interconnecting wiring between the switch boards/control panels, relevant isolators and the various items of equipment.

100.1.12.4 Associated Hydraulics Services Work

Supply and installation of all electrical works associated with hydraulic services including individual isolators for pumps and all interconnecting wiring and cabling between switch boards/control panels and various items of equipment/isolators.

Associated Fire Services Work

Supply and installation of all electrical works associated with fire suppression systems including isolators and all interconnecting wiring and cabling between control panel and various items of equipment.

100.1.13 Contractor Obligations

The Contractor shall produce the work programme based on CPM or Bar chart indicating the time required for various operations to complete the project in time.

The following points shall be high-lighted in the programme:

Mobilisation

Drawing

Approval

Equipment Deliveries

Conduit laying in slabs and walls

Drawing of wires

DB installation

Fixing of switches, sockets etc.

Fixing of light fittings

Fixing of all low current systems devices

Testing

Commissioning

100.1.14 Co-ordination of Services

The Contractor should ensure that all the shop drawings are properly co-ordinated with other services before submitting to The Engineer for approval. All services shall be installed in such a manner so as to avoid conflict with each other and maintain the clearance required between each of them .

The contractor is also advised, in his own interest, to closely liaise with the installation Dept. of the JEPCO and verify from them if the sub-stations layout, together with the relevant plinth details, are currently valid prior to commencement of construction of the sub-station since these are liable to be changed without prior notice.

END OF SECTION

SECTION 1600-200

TESTING AND COMMISSIONING

TESTING AND COMMISSIONING

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200.1 TESTING AND COMMISSIONING

200.1.1 General

The Contractor shall fully test and commission the whole of the electrical installations in accordance with specifications, MOPW&H and I EE regulations and due regard shall be paid to the following Clauses:

The tests shall be recorded in detail and reported to The Engineer.

The Contractor shall then demonstrate that the installations are properly commissioned, that they operate in the correct manner and are capable of functioning to accomplish the design intention as outlined herein.

200.1.2 Works Test

All electrical switchgear and associated equipment shall be tested at the Manufacturer's works before despatch and duplicate test certificates shall be handed to The Engineer. All works test shall be carried out in accordance with the relevant British Standards and codes of practice contained therein.

200.1.3 Site Testing

Site testing of all systems and components comprising the works shall be carried out in the presence of and to the complete satisfaction of The Engineer after the Contractor had first satisfied himself that the installation is functioning correctly.

The Contractor shall provide all certified instruments equipment, plant, labour and materials necessary for conducting specified site tests and shall be responsible for, and prepared to demonstrate the accuracy of all the test instruments supplied by him.

The Contractor shall give The Engineer 3 days notice in writing when any portion of the electrical installation is complete. Should The Engineer not attend within 2 days of receipt of such written notice, then the Contractor may proceed with the tests, however, duplicate certified copies of the results obtained shall be forwarded to The Engineer.

All electrical installations, plant and equipment shall fully satisfy the requirements of the project specifications and those laid down in the IEE regulations as issued by the Institute of Electrical Engineers, 17th Edition.

The Contractor shall be deemed to have included in his price for all safety devices etc., as required by the Engineer.

Observations shall be made of the operation and performance of the installation and subsequent re-adjustments shall be made as necessary.

Records of commissioning and testing shall be kept and when the Contractor has satisfied himself that the installation is functioning correctly, the results shall be comprehensively reported in a bound copy to The Engineer.

Where it is not possible at the particular time of commissioning and / or demonstration of the plant for full load conditions to be obtained or simulated, the Contractor shall repeat the requisite operations of the commissioning and demonstrate under such full load conditions (or the reasonable approximation of such condition acceptable to The Engineer) at the earliest opportunity.

200.1.4 Tests

All alarms, control and protective circuits shall be tested for correct operation.

All light circuits shall be energised and checked to ensure that they are all operational.

All single pole switches and lighting controls shall be checked to ensure correct polarity and that the live conductor has been connected and not the neutral.

All motors, plant and any electrical equipment connected with mechanical services shall be checked to ensure that they run freely in the correct direction of rotation and that they run without undue noise or vibration.

200.1.4.1 Test of Continuity of Ring Circuit

A test shall be made to verify the continuity of all conductors (including the earth continuity conductor) of every ring circuit and all readings shall be tabulated.

200.1.4.2 Continuity of Protective Conductors and Equipotential Bonding

A test shall be made before the connection of an electrical installation to the supply to verify that all protective conductors are connected correctly and electrically sound.

If the protective conductor forms part of a cable such as a core of a multicore PCV-insulated cable or a single protective conductor, a DC ohmmeter may be used to measure the resistance.

Where steel conduit, trunking or other steel enclosures form the protective conductor, the test shall be carried out by use of a high current test instrument at a voltage not exceeding 50 volts AC or DC and at a current approaching 1.5 times normal circuit current up to a maximum of 25A.

When using a DC test supply it must be noted that an inspection of the length of the protective conductor must be made to ensure that there are no inductors fitted.

It is preferable to use a hand generator or other portable instrument to carry out the test so that the disconnected phase conductor can be connected to the consumer's earth terminal and the test can be made between phase conductor and protective conductor at each outlet.

200.1.4.3 Earthing Rod Tests

Upon the installation of an earth electrode, a test shall be made to verify that the resistance of the electrode does not increase the earth fault impedance above the required limit.

Resistance to earth of all earthing rods each earth termination network, continuity of conductors and efficiency of all bends and joints shall be tested by means of a Magger test. In each case, the resistance to earth shall not exceed 1ohm.

200.1.4.4 Insulation Resistance Test

Insulation resistance test shall be made before a completed installation of major alteration to an existing installation is permanently connected to the supply. For these tests, large installations may be divided into groups. A D.C voltage a bit less than twice the normal voltage of the supply (R.M.S value of a A.C. supply) shall be applied for the measurement of insulation resistance provided that for tests on low voltage circuits, the test voltage need not exceed 500V D.C.

When measured with all fuse links in place, all switches (including, if practicable, the main switch) closed and except where earthed concentric wiring is installed, all poles or phases of the wiring electrically connected together, the insulation resistance to earth shall not be less than 1 meg.ohm.

When measured between all the conductors connected to any one pole or phase of the supply and in

turn all conductors connected to each other, pole or phase of the supply, the insulation resistance shall be not less than 1 meg.ohm.

Wherever practicable, so that all parts of the wiring may be tested, all lamps shall be removed and all current consuming apparatus shall be disconnected and all local switches controlling lamps or apparatus shall be closed. Where the removal of lamps and/or the disconnection of current using apparatus is impracticable, the local switches controlling such lamps and/or apparatus shall be open. This test is not applicable to earthed concentric wiring system.

Where apparatus is disconnected for these tests, the insulation resistance between the case or framework and all live parts of each item of fixed apparatus shall be measured separately and shall comply with the requirements given in the appropriate British Standard for the apparatus. If there is no appropriate British Standard, insulation resistance shall be not less than 0.5 meg ohm.

200.1.4.5 Insulation of Site Built Assemblies

Protection against direct contact provided by insulation applied to live parts during erection shall be tested to ensure that the insulation is able to withstand without breakdown an applied test voltage equal to that specified in the British Standard for factory built assemblies: BS 5486. requires the test voltage to be applied between all live parts and the frame of assembly and between each pole and all other poles connected to the frame of the assembly. If the assembly includes a protective conductor, the conductor should be regarded as a separate circuit.

The test voltage should be steadily raised to its full value over a few seconds. Main circuit test voltage depends on the voltage rating of the applied insulation and ranges from 1000V to 3500V AC. The test is considered to have been successful if there is no puncture or flash over.

When protection against indirect contact is provided by additional insulation installed during erection, it must be verified that the insulation enclosure gives a protection of not less than IP2X to BS 5490 and that the insulating enclosure should be able to withstand breakdown or flash-over an applied voltage test equal to that specified in the British Standard BS 5486 "Factory Built Equipment".

For enclosures made of insulating material, BS 5486 requires an additional dielectric test to be carried out by applying a test voltage of between 1500V to 5000V. The test is between metal foil laid on the outside of the enclosure over opening and joints and the interconnected line and exposed conductive parts within the enclosure located next to the opening and joints.

Verification of dielectric properties is not required by BS 5486 for those parts which have already been type tested provided their dielectric strength has not been impaired by their mountings.

200.1.4.6 Protection by Electrical Separation

When the source of supply is a double wound transformer according to BS 3535 or a motor generator set with the same degree of protection or mobile source with double or reinforced insulation, this method of protection is to be used. Only one circuit should be supplied and under no circumstances should that circuit be earthed.

No connections between a live part of a separated circuit and any part of another circuit shall be permitted in case of possible mechanical damage, the flexible cord should be visible over its full length.

Protection by Barrier or Enclosures During Erection

A test shall be conducted according to IEE regulations to ensure the protection by barrier or enclosures during erection.

200.1.5 Verification of Polarity

A verification of polarity shall be made to ensure that all fuses and single pole control devices are connected in the phase conductor only, the centre contact of Edison type screw lamp holders are connected to the phase conductor and the outer metal threaded part is connected to neutral conductor. Wiring to plugs and socket outlets should be such that they are connected with phase conductor on the right terminal when inspected from front.

200.1.6 Earth Fault Loop Impedance Test

A test shall be conducted for the effectiveness of the earthing of each completed installation by means of an earth fault loop impedance test. This test shall be carried out by using an earth loop impedance test instrument.

Operation of Residual Current operated and Fault Voltage Operated Protective Devices.

A test shall be conducted to check for instantaneous operation of the above devices by external means. The testing device shall be a single phase double wound mains transformer with an output voltage not exceeding 50 volts (rms) A.C. having a short period rating of 750 VA (minimum) and shall be connected across the circuit line conductor and circuit protective conductor of an residual current operated device, or the neutral and frame terminals of a voltage-fault operated device.

In the case of the former, the device should trip within the time delay declared by the manufacturer and in the case of the latter, the device should trip instantaneously.

On completion of sections of the work, the Contractor shall test the electrical installation in accordance with current IEE and local regulations.

Duplicate copies of the final test results and of the certificates described in the current IEE regulations shall be submitted for approval to The Engineer. The Contractor shall provide instruments for all tests.

200.1.7 General Commissioning

The Contractor shall:-

- a. Set all units and apparatus to work.
- b. Adjust and set up all automatic controls, regulating devices, measure and adjust any plant under his responsibility, duties and ratings and performance of all components for all items installed separately and integrated into the installation as a whole.
- c. Record in detail each step and stage of commissioning and test results, reporting the test stages until the tests are satisfactory.
- d. The Contractor shall carry out insulation, continuity, each loop impedance, switching and sequencing, direction of rotation and all other tests required under the IEE regulations, 16th edition.
- e. Should the tests carried out fail to demonstrate that the plant and equipment is correctly installed and / or functioning correctly, The Engineer shall decide whether such failure is due to negligence on the Contractor's Part (including, in this context as defined, all his sub-contractors and suppliers) in which case, the Contractor shall carry out all remedial works entirely at his own expense.
- f. After remedial works have been completed the Contractor shall again report to The Engineer for further tests to be carried out. Engineer decision as to what constitutes a satisfactory result shall be final.

200.1.8 Commissioning & Testing Of Distribution Systems

The completed installation or parts thereof shall be subjected to acceptance tests as instructed by The Engineer before being connected to the permanent power supply.

The following tests shall be included as applicable:

- Tests as prescribed in the JEPCO regulations.
- Tests in accordance with British Standards and Codes of Practice contained therein.
- Insulation resistance.
- Earth continuity.
- Continuity, resistance of conductors and sheathing of each section and the whole installation.
- Full load tests as required by The Engineer.
- Current Injection tests of all over-current devices and residual current operated circuit breakers etc. Acceptance tests shall be carried out in the presence of The Engineer. The Contractor shall give 7 days written notice of intention to carry out any of the tests.

200.1.9 Operation and Maintenance Manuals

Prior to practical completion the Contractor shall provide four copies in the form of bound documents the Operating Instructions and Maintenance Manuals indicating the following:

Step by Step operating procedures

Preventative maintenance schedule

Technical literature

Spare parts list

Manufacturer's Name, Address, Telex/Fax No, Telephone No. and the name of the Contact Person

Work Test Certificates, if any

Routine Test Results carried out at site.

Copy of all warranties/guarantees

Signed off commissioning reports

Approved "As Built" drawings"

200.1.10 Mechanical Services

The Contractor shall be responsible for ensuring that he has included in his tender for all necessary electrical works associated with the mechanical and plumbing engineering services. This shall include all necessary cables, cable trays, trunking, conduits, isolators, terminations, etc.

END OF SECTION

SECTION 1600-205

List of Recommended Manufactures

List of Recommended Manufactures

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1. LIST OF RECOMMENDED MANUFACTURERS

General:

- a) The design is based on the equipment performance under listed in this section.
- b) The tender pricing shall be based on any of the under listed manufacturers / brands for each type / system.
- c) The contractor must submit the base tender complying with the under listed manufacturers. An alternative offer from alternative manufacturers may be submitted in addition to the base tender, provided that full substantiating data of the equipment, and noting of the non-compliant features of the alternative equipment / system together with the cost implications is provided.

All alternative equipment /system offers may be accepted or rejected at the sole discretion of the Engineer as it shall be subject to the review, approval and final acceptance of the Engineer.

- d) Submit the compliance form with the Tender indicating the proposed manufacturer(s) for major equipment / system. Treat all equipment / system for which data submissions are required as major equipment / system for this purpose.
- e) Changes from the listed equipment / system offered during the tender stage will not normally be permitted unless the Engineer is satisfied that there is significant advantage in Principle.

1. All switchgears; Main Distribution Boards, Sub-main, secondary distribution boards and motor control centre
Schinder Electric -France
ABB-Italy
AEG-Germany
Legrand-France

Notes;

- a) Local Firms having an experience of ten years minimum in assembling of main panel, sub-main boards, MCCs , and the like of similar capacity and/or ratings is be accepted and subject for the Engineer approval.

Local assembler shall be certified as a panel builders by the international manufacturers.

- b) All panel boards enclosures shall be manufactured by Rital , ELDON or Himel, local made enclosures are not accepted.
- c) Local assembling of the secondary distribution boards shall not be accepted, all secondary distribution boards shall be factory made.

2. Starters, relays, contactors, indication lamps, push buttons, selector switches, motion /presence detectors, wiring terminal blocks ..etc

Telemecanique -France

ABB-Italy

AEG-Germany

- | | | |
|-----|-----------------------------|--|
| 3. | Emergency Lighting | Legrand-France
EMERGI-LITE - UK
Thron -UK
JSB (UK)
Chloride Electronics (UK) |
| 4. | Wiring Accessories | MEM - UK
MK - UK
Legrand – France |
| 5. | PVC Conduits | Gulf plastic-Jordan
Decoduct-UAE
Addasani-Kuwait |
| 6. | G.I. Conduits | National- Japan
Burntubes- UK
Barton - UK
Marshall Tufflex - UK
Ackerman - Germany |
| 7. | GI Cable Trays and Trunking | Wiremold-UK
Davis-UK
Swifts-UK
BEN certified Saudi made |
| 8. | Wiring/Power Cables | Ducab-UAE
Oman Cables-Oman
Jordan New cable -Jordan
CABELCO-Jordan
Riyadh Cables-KSA |
| 9. | Isolators | Stromsburg-Germany
MK-UK
ABB-Germany
Legrand-France
BACO-Germany |
| 10. | Cable Glands | BICC - UK |

11. Earthing System

Helita-France

Furse - UK

Wallis - UK

12. Indoor Lighting; Fixture's shape, design, finishes and performance as per the catalogue cuts, products quality as made by:

Trilux – Germany

Philips – Netherlands

Thorn –UK

13. Outdoor Lighting ; Fixture's shape, design, finishes and performance as per the catalogue cuts, products quality as made by :

Iguzzini – Italy

Bega - Germany

We-ef – Germany

14. Telephone Cabling & Junction Box System, and cable

Seimon/Beldon (Italy, USA)

KRONE (Germany)

DUCAB (UAE)

leviton (USA)

R&M (USA)

END OF SECTION

SECTION 1600-210

CONDUITS AND CONDUITS BOXES

CONDUITS AND CONDUIT BOXES

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210.1 CONDUITS AND CONDUIT BOXES

210.1.1 Galvanised Steel

Steel conduit shall be galvanised, heavy gauge, solid drawn and shall comply with BS 4568 Part I. Each length of conduit shall bear a stamp guaranteeing it to be as per specifications. The use of conduit less than 20mm will not be permitted.

All conduit fittings and accessories including threaded couplers, ordinary clips, saddles, pipe hooks, threaded reducers, stopping plugs, locknuts and male and female bushes shall comply with BS 4568 Parts 1 and 2 wherever applicable.

All exposed and/or surface mounted electrical installations shall be carried-out using galvanized steel conduits and its accessories.

210.1.2 Fittings

All threaded couplers, reducers and locknuts shall be made of galvanised malleable iron and all stopping plugs, male and female bushes made of brass. Round locknuts only shall be used on surface work.

Inspection elbows, bends and inspection couplings must not be used.

210.1.3 Adaptable Boxes

Galvanised sheet steel adaptable inspection boxes shall be provided and fixed in inspection positions where more than two conduits cross. These boxes shall be 150 x 150mm deep inside measure. Where the boxes are fully recessed they shall be provided with 14 AWG mild steel lids, overlapping the boxes 6mm all around.

In damp and external situations, galvanised malleable cast iron adaptable boxes shall be used. The boxes shall be provided with neoprene seals and galvanised malleable cast iron lids secured by four M4 brass round head screws. The boxes shall have external fixings lugs.

Boxes shall be fixed with a minimum two numbers 10mm round head brass screws in plastic wall plugs.

No more than three conduits up to 25mm will be allowed per side on the above adaptable boxes.

Where more than three conduits per side occur, larger boxes shall be used. Deeper boxes shall be provided for conduits larger than 25mm dia.

Conduits shall be fixed to adaptable boxes, fuse boards, switches etc., by means of smooth bore male brass bushes and couplers. For concealed work, brass compression washers shall be used together with the male bush and coupler.

Spanners or purpose made tools shall be used to tighten hexagonal bushes. Pliers and toothed wrenches shall not be used.

210.1.4 Draw Boxes

Where cables of 6mm² or over are being drawn in, 150mm x 75mm x 37.5mm galvanised adaptable boxes shall be used as draw boxes to minimise the bending of the cable.

The heavy duty cast iron type fitted with neoprene gaskets shall be used for external works.

210.1.5 Circular Inspection Boxes

Small standard circular galvanised conduit boxes shall be provided and fixed at all junctions and the necessary angles and bends of conduit.

To match the wall spacing and the distance saddle, a galvanized cast iron lid shall be used to pack the

conduit box off the wall.

Conduit boxes mounted outside a building shall have external fixing lugs. The boxes shall be fitted with galvanised light steel covers when used internally, overlapping type on flush work and recessed covers when used externally and in damp situations.

210.1.6 Installation of Conduits

All conduits must run vertically or horizontally, diagonal runs will not be permitted on walls. All conduits, conduit fittings and equipment shall be erected prior to any cables being drawn in.

Conduit installed in concealed positions such as ceiling or floor space shall be fixed by spacer bar saddles, fixed not more than 900mm apart to the fabric of the building as specified above.

Conduit buried in concrete shall have 37mm depth of cover over its entire length. Conduit buried in plaster shall have 16mm depth of cover over its entire length.

Conduits penetrating through roof slabs shall be complete with gooseneck and sealed.

Conduits installed in chases shall be fixed with corrugated steel clips secured with hardened steel pins at 1200 mm centres.

Conduits laid on concrete floor slabs shall be fixed by means of corrugated steel saddles secured by hardened steel pins at 1200 mm centres. On pre-stressed floor slabs fixing must be into the joints between the beams unless instructed otherwise by The Engineer.

In 'cast-in-situ' applications, the Contractor shall ensure adequate precautions are taken for the secure fixing, positioning, alignment and protection of all conduits and boxes during the building operations. No steel conduits are to be cast in-situ unless previously insulated with proprietary wrapping tape such as denso.

All conduit outlets or other 'in-situ' construction must be plugged with extreme care to prevent the ingress of foreign matter and the conduit system from becoming blocked during building construction. The Contractor will be held entirely responsible for any additional costs resulting from blockage or damage to conduits due to negligence or lack of attendance.

Female brass bushes shall be screwed on to all free ends of conduits.

The conduit system shall be screwed on to all free ends of conduits.

The conduit system shall be electrically and mechanically continuous and water tight after installation.

All conduit systems shall be arranged wherever possible to be self-draining to conduit boxes and outlet points. Where necessary, provision shall be made to counteract condensation as directed by The Engineer.

Immediately before wiring, all conduit systems shall be thoroughly swabbed out until dry and clean. No steel conduit installations shall be used as an earthing system. Separate earth shall be installed in all cases. However, steel conduit installations shall be electrically continuous and connected to earth. All spare ways in junction boxes etc. left for possible future extensions shall be fitted with brass stopping plugs.

for wiring purposes, all draw-in and inspection boxes must be installed in readily accessible positions, which have been agreed to by The Engineer.

Corners shall be turned by easy bends or sets made cold without altering the section or opening the seams of the conduit. No bend shall have an inside diameter of the conduit. All bends must be machine made.

The inside surface of all conduits and conduit fittings shall be smooth and free from burrs and other defects.

210.1.7 Expansion Couplers

Conduits crossing expansion joints shall be joined by means of an expansion coupler. The coupler shall be wrapped with building paper for a distance of 300mm on either sides. An inspection box shall be fitted as close as possible on each side of the expansion coupler and a copper earth continuity conductor complying to BSEN regulations installed in the conduit between the boxes. The earth wire shall be terminated at each box by means of an M4 brass right hand screw tapped into the bottom of the box and 2 nos. flat brass washers.

210.1.8 Conduit Joints

The joints shall be made tight by painting the threads just before joining with special high conductivity aluminium paint. Running joints shall only be used where absolutely necessary and they shall be painted with two coats of aluminium paint as soon as they have been tightened.

210.1.9 Flexible Joints

Where specified, the final connections to machines and other items of apparatus shall be with galvanised metallic flexible conduit. The interconnection between the solid and flexible conduit shall be via small conduit box.

210.1.10 Polyvinyl Chloride Conduit & Accessories

All recessed/embedded electrical installations shall be carried-out using PVC conduits complete with its accessories (Back boxes for socket outlets and lighting switches shall be galvanized steel).

All plastic conduits shall be of rigid un-plasticised PVC of the high impact grade. The impact strength shall be tested in accordance with BS 2782. No conduit smaller than 20mm shall be used. All PVC conduits shall be of heavy grade.

Where a solid fixed joint between a conduit and an accessory is required, use shall be made of an adhesive recommended by the manufacturer or the plastic conduit. When making a joint, care must be taken to ensure that the plastic conduit is thoroughly cleaned at the ends to ensure good adhesion. Rigid joints shall be made using a solvent cement to produce a rigid tight joint and shall be used with standard couplers and accessories. Flexible joints shall be made using a non-hardening adhesive and shall be used in conjunction with expansion couplers. Where bends or off-sets are required, these shall be made in accordance with the manufacturer's instruction without altering the section of plastic conduit. For PVC conduits up to 25 mm diameter, cold bends shall be acceptable. The bends shall be formed with the use of bending spring obtained from the plastic conduit manufacturer. For larger sizes of conduit, bends shall be formed by pre-heating the tube before inserting a rubber core to prevent kinking. Pre-heating shall be done with a blow lamp, care being taken to avoid over-heating the surface either by the application of hot water by immersion, or wrapping hot cloth around the section to be set.

PVC conduits shall not be installed in situations where continuous ambient temperatures exceed 60°C or where for intermittent periods, the ambient temperature exceeds 70°C. Badly formed plastic conduit or plastic conduit damaged in any way shall not be permitted.

Expansion couplers shall be used on all straight runs of plastic conduit exceeding 6 metres in length. The plastic conduit shall be free to slide within saddles. Special consideration should be given to fixing of accessories in situations where the temperature fluctuates couplers.

The Contractor shall exercise care when installing PVC conduit to prevent interference with, or from other services and shall keep at least 300 mm clear of hot water pipes.

The conduits shall be laid concealed in the concrete slab and walls. This includes conduits for the socket outlets and telephones.

No equipment weighing more than 12 kg shall be suspended from circular PVC boxes. Heat resistant conduit boxes shall be used throughout where they support equipment. All suspension screws used for this purpose shall be supplied by the manufacturer.

Where enclosed tungsten luminaries are fixed directly to a PVC high impact circular conduit box, then steel insert clips must be used for fixing the luminaire to the box.

END OF SECTION

SECTION 1600-220

CABLES AND SMALL WIRING

CABLES AND SMALL WIRING

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220.1 CABLES AND SMALL WIRING

220.1.1 GENERAL

220.1.1.1 Scope

1 This Part specifies the general requirements for power cables and small wiring systems. It shall be read in conjunction with other parts of the Project Documentation.

2 Related Parts and Sections are as follows:

This Section Part 1 General Provisions for Electrical Installations

Part 7 Conduits

Part 8 Trunking

Part 9 Cable Trays

Part 10 Wiring Accessories and General Power

Part 23 Testing

220.1.1.2 References

1 Cables and wires shall comply with the following standards as appropriate:

BS 1442 Galvanized mild steel wire for armouring cables

BS 2484 Straight concrete clay ware covers

BS 2897 Aluminium strip armour for cables

BS 3506 Un-plasticised PVC pipe for industrial purposes

BS 4066 (IEC 332) Tests on electric cables under fire conditions

BS 4660 Un-plasticised polyvinyl chloride (PVC-u) pipes and plastic fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage

BS 5308 Instrumentation cables.

BS 5467 (IEC 502) Cables with thermosetting Insulation for electricity supply for voltages of up to and including 600/1000 V and 19000/30000 V

BS 6004 (IEC 227) PVC insulated cables (non-armoured) for electrical power

BS 6007 Rubber insulated cables for electric power and lighting

BS 6207 (IEC 245) Mineral insulated cables.

BS 6234 Polythene insulation and sheath for cables.

BS 6346 PVC insulated cables for electrical supply.

BS 6360	(IEC 228) Copper conductors for cables.
BS 6500	(IEC 227) Insulated flexible cords.
BS 6622	(IEC 502) Cables with extruded cross linked polyethylene Insulation, for rated voltage 3800/6000 V up to 19000/30000 V
BS 6746	PVC Insulation and sheath of electric cables
BS 6746C	Colour chart for insulation and sheath of electric cables
BS 6899	Rubber insulation and sheath of electric cables
BS 7671	Requirements for electrical installations
ISO 9000	Quality management and assurance standards
BS EN 29453	Soft solder alloys-chemical composition and forms

2 Cable terminations shall comply with the following specifications:

BS 1858	Bitumen based compounds for electrical purposes
BS 4579	Performance of mechanical and compression Joints in electric cable and wire connectors
BS 6121	Mechanical cable glands for elastomer and plastic Insulated cables
BS 6910	Cold pour resin compound and heat shrink cable joints in the voltage range up to 1000 V AC and 1500 V DC

220.1.1.3 Quality Assurance

- 1 The Contractor shall determine the correct size of cables to be used for the equipment selected, based on current rating and voltage drop, as relevant, after taking into consideration:
 - (a) type of cable and wire
 - (b) ambient conditions
 - (c) method of installation
 - (d) the disposition of each cable relative to other cables
 - (e) fault power level
 - (f) protective device ratings
 - (g) motor circuit voltage drop during starting.
- 2 Voltage drop and current ratings shall be calculated according to LOCAL CODE AND STANDARDS Regulations or BS 7671 and IEE regulation, whichever is more stringent.
- 3 All cables and wires shall be suitable for installation and continuous service in the ambient conditions described in Part 1, and shall be manufactured to ISO 9000 or equivalent.

- 4 Approximate cable route lengths and equipment power ratings indicated on the Project Drawings shall be for calculating cable sizes for tendering purposes. The Contractor shall determine exact cable lengths from site measurements and calculate cable size from the power ratings of the actual equipment being proposed. The Contractor shall be responsible for any increase in costs or design work associated with proposed equipment which has different electrical characteristics than the equipment on which the design was based.
- 5 Cables from manufacturer whose product had been in satisfactory use in similar services in the project's country for not less than 5 years shall be used only. Certificate of origin shall be submitted with the offer.

220.1.1.4 Submissions

- 1 Shop Drawings and Product Data:
 - (a) submit full technical details including cable sizing/voltage drop calculations and catalogue information of each type of cable or wire proposed for the Engineer's approval before ordering
 - (b) submit copy of test certificates from the manufacturer or an independent testing authority confirming that cables comply with the Specifications
 - (c) submit exact route of the cable runs and relevant Sections in the shop drawings, including fixing details, termination details etc.

220.1.1.5 Products Delivery, Storage and Handling

- 1 Reference Part 1.
- 2 Each drum length of cable shall be allotted a distinct and separate reference number. This number shall appear on the test certificates covering the respective length of cable and shall also be clearly marked on the cable drum.
- 3 The Contractor shall advise the Engineer upon delivery to site of each drum length, quoting the reference number. The test certificates shall be handed to the Engineer for examination and approval.
- 4 All cables shall be delivered to site with the manufacturer's seals, labels or other proof of origin intact. These labels and seals shall not be removed until the cable is required for use and shall be retained for inspection by the Engineer.
- 5 The Contractor shall be responsible for the off-loading and handling of the cables on site, and shall ensure that cables are delivered to site on drums and properly protected against mechanical damage. Where lengths are cut from cables, the open cable ends shall be sealed to prevent ingress of moisture.

220.1.2 PRODUCTS

220.1.2.1 Performance Requirements for Environmental Conditions

- 1 The Contractor shall be aware of the need to supply and install all wire and cables for this Contract which are most suitable for the special environmental conditions prevailing in Project Site.
- 2 All conductors shall have good fatigue resistance and not be subject to breaks due to nicks or cuts when terminating.

220.1.2.2 Cables

- 1 Unless otherwise specified, cables and wires of the following specified voltage ratings shall be used as indicated.
 - (a) 6350/11000 V rated cables : 11kV ring and radial circuit
 - (b) 600/1000 V rated cables : Main and sub-main distribution panels, motor control centres, circuits serving process equipment
 - (c) 450/750 V rated cables : Final sub-circuit supplies for lighting, socket outlets, etc.
 - (d) 300/500 V rated cables : Instrumentation
 - (e) 250 V rated cables : Extra low voltage wiring, communication circuits where the maximum voltage is 50 V.
 - (f) Special screened cables : Music/paging systems, nurse call , and intercom cable twisted pair conductors circuits
- 2 General:
 - (a) conductors shall be high conductivity copper, to BS 6360 (IEC 228) unless otherwise indicated
 - (b) copper conductors shall be stranded
 - (c) signal control cables shall have solid conductors
 - (d) flexible cords shall have fine stranded conductors
 - (e) conductor sizes shall be metric. Conductors with cross sectional areas smaller than those specified will not be accepted
 - (f) insulation for each conductor shall be colour coded or otherwise identified as required by the Regulations. Colour coding shall be maintained throughout the installation
 - (g) the current carrying capacity of conductors has been determined in accordance with the specified Regulations, the specified type of insulation and the expected conditions of installation
 - (h) all cables shall be as far as practicable, of one manufacturer only. All cables shall comply with the relevant IEC/BS.

- 3 600/1000 V rated PVC Insulated armoured cables.
- (a) PVC/SWA/PVC cable: 600/1000 V Grade, to BS 6346
 - (b) conductor: Annealed high conductivity copper, stranded, shaped and laid in an approved manner
 - (c) armour: Single layer of galvanised steel wires for multi-core cables
 - (d) insulation: Colour coded to BS 6746C
 - (e) PVC for sheath and insulation to BS 6746
 - (f) cables shall be terminated with compression glands as specified below, giving adequate mechanical support by locking on the armour and ensuring a high earth continuity.
- 4 PVC Insulated PVC Sheathed (PVC/PVC) Cable.
- (a) to BS 6346, 600/1000V Grade, or to BS 6004, 300/500 V Grade
 - (b) flat twin and three core cable shall be to BS 6004 and incorporate an earth conductor placed between the red and black cores for two core cable and between the yellow and blue cores for three core cable
 - (c) conductor: annealed high conductivity copper, stranded, shaped and laid in an approved manner
 - (d) insulation: Colour coded to BS 6746C
 - (e) PVC for sheath and insulation : to BS 6746
- 5 Single core PVC Insulated Wires:
- (a) cable shall be to BS 6004, rated 450/750 V, with high conductivity copper conductors and PVC compound insulation. Colour coding shall be in accordance with table 51 A of BS 7671
 - (b) wires shall be continuous from outlet to outlet and no splice shall be made except within outlet and junction boxes. A separate neutral wire shall be provided for each circuit. Wires shall be left sufficiently long enough (minimum 150 mm) to permit making final connections.
- 6 Mineral Insulated Cable:
- (a) to BS 6207 : Part 1, rated 600/1000 V
 - (b) cable shall comprise of a pressure packed magnesium oxide insulation contained within a continuous soft ductile copper sheath and copper conductors embedded in the dielectric in standard formation
 - (c) cable termination kit shall comprise of conductor insulation of neoprene sleeving retained by cone shaped beads beneath a fibre sealing disc. Each conductor shall be identified with regard to phase etc., by means of sleeving placed over the neoprene insulation
 - (d) cable seals shall comprise of screw-in-pot type seals, with brass ring glands designed to accommodate the pot seal.

7 Terminals:

- (a) for cable up to 6 mm²: two screw pinching type
- (b) for cable over 6 mm²: grip lug type cable sockets
- (c) brass saddles: purpose made, two fixing screw type.

8 Heat Resistant and High Temperature cable:

- (a) to BS 6500, or BS 6004 300/500 V grade, designated EPR (ethylene polypropylene rubber) insulated HOFR sheathed, 85 °C or EPR insulated OFR sheathed, 60 °C. Conductor(s) shall be flexible class 5 tinned copper to BS 6360. Insulation shall be type GP.1 to BS 6899. Outer sheath shall be HOFR (heat, oil, fume resistant) or OFR (oil and fume resistant) sheath type RS3 to BS 6899 and flame retardant to BS 4066 Part 1, temperature rating 60 ° or 85 °C
- (b) high temperature cable shall be to BS 6500 or BS 6007, designated 300/500 V grade silicone insulated glass braided, 180 °C. Conductors shall be flexible class 5 tinned copper to BS 6360. Insulation shall be silicone rubber type EI 2 to BS 6899. Outer sheath shall be treated glass fibre braid, temperature rating 180 °C.

9 Flexible Cable:

- (a) to BS 6007, or BS 6500, rated in accordance with manufacturer's tables
- (b) flexible cables subject to excessive heat shall be insulated as (8) above, (a) or (b) as per the Project Documentation requirement.

10 600/1000V rated XLPE Insulated Cable

- (a) to BS 5467, 600/1000V grade, designated XLPE/SWA/PVC for armoured multi-core cable, and XPLE/PVC for unarmoured cable (b) conductors : plain annealed copper to BS 6360
- (c) cable shall comprise of plain copper, stranded circular conductors insulated with an adequate thickness of extruded cross linked polyethylene (XLPE)
- (d) conductors shall be laid up together and warmed circular with suitable performed fillers and warnings, bound with polythene terephthalate (PTP) tape and covered with an extruded PVC sheath, minimum 1.4 mm thick for multi-core cable
- (e) armoured multi-core cable shall have steel wire armouring and extruded sheath of black PVC
- (f) armoured single core cable shall have aluminium wire armouring and extruded sheath of black PVC
- (g) outer sheath of single core cables shall be at least 2.5 mm thick
- (h) conductor screen : non-metallic comprising either semi-conducting tape or a layer of extruded semi-conducting material
- (i) prevent void formation in insulation by careful control of its passage through temperature graded water baths
- (i) cable shall be terminated with compression glands as specified below, giving adequate mechanical support by locking on the armour and ensuring high earth continuity.

11 6350/11000V Cable for medium voltage networks

- (a) cable shall be armoured type, rated 6350/11000 Volts, and shall comply with
BS 6622. Single core cable shall be designated 11 kV XLPE/AWA/PVC. Multi-core cable shall be designated 11 kV XLPE/SWA/PVC
- (b) conductors shall be stranded copper complying with BS 6360, covered with a semi-conducting screen extruded on to the conductors
- (c) insulation shall be extruded cross linked polyethylene suitable for continuous operation at 90 °C, able to accept a final temperature of 250 °C in the event of a short circuit, and covered with a screen consisting of an extruded semi-conducting layer and a copper tape layer
- (d) armoured cables shall have a secure bedding, over the core or core assembly, for the armour. For single core cable, the bedding shall consist of a PVC sheath. For multi-core cable, the bedding shall consist of non-hygroscopic fillers

(e) single core cable shall have aluminium wire armour. Multi-core cables shall have galvanised steel wire armour. Cable shall be covered with a red coloured PVC sheath

(f) electrical design stress at any point in the insulation shall not exceed 3 kV per mm

12 Instrumentation Cables - Analogue Signals:

(a) to BS 5308 part 2, type 2,300-500 V

(b) single copper conductor 1/0.8 mm

(c) polyethylene insulation

(d) individual screen of aluminium backed polyester tape with tinned copper stranded drain wire

(e) collective screen of aluminium backed polyester tape with tinned copper stranded drain wire

(f) extruded PVC bedding

(g) galvanised steel wire armour

(h) PVC outer sheath, grey

(h) core identification as BS 5308 Part 2.

13 Instrumentation Cables - Digital Signals:

(a) to BS 5308 part 2, type 2 300-500 V

(b) single copper conductor 1/0.8 mm

(c) polyethylene insulation

(d) collective screen of aluminium backed polyester tape with tinned copper stranded drain wire

(e) extruded PVC bedding

(f) galvanised steel wire armour

(g) PVC outer sheath, Gary

(h) Core identification as BS 5308 Part 2.

14. Pilot cables shall comply with following requirements:

1. Pilot cables shall be PVC insulated multi core cables to be used for:

- ▶ Standard pilot wires protection schemes
- ▶ Telecommunication purpose.

2. Conductors shall be stranded copper, plain annealed and in accordance with BS 6360.

3. Core insulation shall be PVC complying with requirements of BS 6746. It shall be applied by an extrusion process and shall form a compact, homogenous body of uniform thickness. Insulation thickness shall be in compliance with BS 6346.

4. Core identification shall be by one of the following:

- a) Number printed on the core insulation
- b) Colour, 4mm cores having colours Red, Blue and Black.
5. Bedding shall be compliance with BS 6346.
6. The cables shall have a single layer of galvanised steel wire armour of diameter 1.6mm in accordance with BS 6346.
7. The over-sheath shall be of black PVC in compliance with BS 6746 Type 1 compound. It shall have a minimum thickness of 1.7mm and shall be in general compliance with BS 6346.

220.1.2.3 Sundries

1 Cable Jointing and Termination:

- (a) joints in wires and cable shall be avoided wherever possible. Joints in flexible cables and cords are not permitted
- (b) joints and terminations of all power cables shall be made by skilled cable jointers approved by the Engineer
- (c) no reduction in the number of strands of a cable core shall be allowed at a cable joint or termination
- (d) ferrules, compression connectors and bare portions of cable core resulting from a jointing or terminating process shall be insulated with an approved type of insulating tape or heat shrinkable tubing after completion of process. Such insulating tape or heat shrinkable tubing shall have equal or better electrical and mechanical properties than those of the original insulation removed, and shall be adhered to the cores etc. securely and permanently. The final thickness shall be in smooth contour throughout the whole length
- (e) every compression joint shall be of a type which has been the subject of a test certificate as described in BS 4579. When a compression joint is made, the appropriate tools specified by the manufacturer of the joint connectors shall be used.
- (f) a circuit protective conductor having adequate cross sectional area and of same material as the phase conductors shall be installed and connected to maintain the effectiveness of the earth continuity across every cable joint
- (g) all cable jointing and termination shall be witnessed by the Engineer
- (h) sufficient spare cable shall be allowed to remake the joint or termination
- (i) above ground cable joints and terminations shall be accessible
- (j) cable cores shall pass through glands or termination boxes directly to equipment terminals, without crosses if practicable.

2 Joints

- (a) straight through joints for copper conductors: Where permitted by the Engineer, conductors shall be jointed by approved type compression connectors using the appropriate tools and connectors

- (b) joints shall be made core-to-core.

3 Joints Boxes and Termination Boxes

- (a) malleable cast iron boxes for joints in all power cables shall be compound filled and of adequate size. The boxes shall be fitted with suitable armouring clamps and glands. The armouring of the cables shall be terminated at the armouring clamps and the inner sheath shall pass through the gland. Self amalgamating tapes shall be applied to give fully screening insulation reinstatement where the insulation is screened
- (b) the box and compound shall be at the correct temperature before the compound is poured to allow total adhesion between the compound and the box. The compound shall then be allowed to cool and topped up before the box is closed. No air locks shall be formed within the box
- (c) with the consent of the Engineer, plastic shells fitted with suitably sized armour bond and filled with an approved type of cold pouring encapsulating compound to BS 6910 may be used as an alternative to the compound filled cast iron joint boxes for jointing PVC-insulated power cables. In such cases, the complete jointing kit, including plastic shell, compound, insulating tape etc. shall be from the same proprietary manufacturer who is specialised in manufacturing products for this purpose. The jointing methods and procedures, as laid down by the manufacturer, shall be followed in strict accordance
- (d) MICC mains cable: joints shall be suitably sized galvanised malleable iron adaptable box with glands and fixed base mechanical clamping connectors of approved design. For external use the jointing box shall be enclosed in a second galvanised box with glands, filled with encapsulating compound

4 Cable Glands

- (a) cable glands shall be used for terminating cables to switch gear, switch boards, motor control centres, motors and other equipment
- (b) they shall be brass compression glands and comply with the relevant part of BS 6121, except for MICC cables, which shall comply with BS 6207 Part 2.
- (c) glands for armoured or screened cables shall have suitable clamps
- (d) external compression glands shall have close fitting PVC shrouds
- (e) earthing for armouring and metallic sheaths: suitable brass or copper clamps, and copper strip conductor in accordance with LOCAL CODE AND STANDARDS requirements, and not less than 2.5 sq. mm
- (f) cables forming part of a LAN or structured cable system shall be terminated to floor plates or wall sockets compatible with the media interface connector specified for the particular network being used.

5 Cable Sockets:

- (a) shall be correct size for type of cable
- (b) shall be sweating type, or an approved crimping type used with an approved crimping tool
- (c) sweating sockets for conductors 70 sq. mm. and over shall be machined cast brass.

- 6 Fire Barriers:
- (a) shall be purpose made, comprising a rigid fixed frame with adjustable seals and a suitable clamping device
 - (b) in fire compartment separation walls and floors shall be same standard of fire resistance as wall or floor.
- 7 Cable Covers: shall be to BS 2484 and concrete covers exceeding 300 mm wide shall be reinforced.
- 8 Pipe Ducts : shall be PVC or as indicated.
- 9 Solder: an alloy of lead and tin to BS EN 29453 grade F or H, unless otherwise recommended by cable manufacturer.
- 10 Cable Sealing Compounds: shall be tropical grade to BS 1858 or BS 6910 and approved by cable manufacturer, of an oil-resisting compound where the difference in level between cable ends exceeds 6 m.
- 11 Cleats: shall be an approved claw type cast aluminium, gunmetal, plastic or brass of approved type, two bolt fixing for cables greater than 50 mm diameter.
- 12 Cable Markers:
- (a) shall be precast concrete, minimum size 300 x 300 mm x 100 mm deep
 - (b) the markers shall be engraved "HV CABLE", "ELECTRIC CABLE", "ELV CABLE", "EARTH PIT" or "CABLE JOINT", as applicable
 - (c) cable marker construction details and engravings shall be approved by the local authorities.

220.1.2.4 Wiring System

The Contractor shall carry out the electrical installations in accordance with the following brief:

(a) Mains

Unless otherwise specified; the local power supply authority / company will supply the high voltage switch gear, high voltage cables and associated protection,

Unless otherwise specified; transformers and the cables from the transformers to the main panel shall be provided by the Contractor.

The Contractor shall supply the main switch boards as detailed in the tender drawings and specifications and conforming to the local power supply authority / company regulations and the technical specifications of project.

(b) Sub Mains Feeders

Sub-Mains feeders between the main LV panel and sub-main panel/distribution boards/isolators shall be carried out using armoured and/or non-armoured cables laid in ground or on cable trays as indicated on the tender drawings.

Where variations occur to the scheme during the progress of the work, cable sizes shall be checked by the

Contractor and sized to avoid a drop in potential exceeding 1½ of the stated voltage.

(c) Final Circuit Wiring

General

Cables for lighting, small power and control circuits shall not be smaller than 2.5mm² when using PVC insulated cables.

General power outlets shall be installed using 2.5 or 4 mm² PVC insulated cables.

Circuits to motors and other items of mechanical plant shall use the size and type of cable designated on the drawings or rated to suit the connected load of the particular item of plant. Where variations occur to the scheme during the progress of the work, cable sizes shall be checked by the

Contractor and sized to avoid a drop in potential exceeding 1½ of the stated voltage.

A separate circuit protective conductor shall be installed in all conduit and trunking runs and connected to all outlet boxes and equipment cases.

Lighting System

From each distribution board designated for lighting services, the Contractor shall provide lighting circuits as required and circuits shall include cable trunking, conduit, conduit accessories, cables, lighting switches and all other materials and equipment necessary to complete the installation. A luminaire complete with lamp(s) shall be provided at each point indicated on the drawings. Lighting sub-circuits shall generally be as detailed on the appropriate drawings. Where circuiting has not been detailed, the Contractor shall submit to the Clients Representative for his approval, before any work is put in hand, a table showing the proposed arrangement of lighting sub-circuits and the size of cables to be used. When preparing this table, loading of the sub-circuits shall be limited to 50% of the final sub-circuits protective device rating. Attention is also directed to compliance with the appropriate clause of the IEE Regulations – Loading of Final Sub-Circuits.

Where suspended ceilings exist, the conduits may be run on the structural soffit. Where conduits are required to cross and expansion joint in the building structure, flexible conduit shall be employed of suitable length to span the joint.

Unless otherwise detailed, luminaires shall be fixed directly to conduit boxes or lighting trunking and care shall be taken to ensure that these are adequately secured to accept the weight of the luminaires.

In cases where luminaires are mounted on trunking, they shall be fixed directly to the trunking using proprietary suspension sets.

In all other cases the installation shall terminate directly onto the luminaire or in a standard Besta

Box with the luminaire mounted directly to the box.

Luminaires may not be erected until the building is enclosed and watertight. Damage to luminaires and in particular to their paint finish resulting from premature installation may result in The Engineer requiring their removal and replacement without cost to the Employer.

Throughout suspended ceiling areas where recessed modular fluorescent luminaires are to be installed, final connection of each luminaire shall be made by means of a 3 core flexible cable of suitable heat resisting qualities via a 'plug-in' ceiling rose connected to the conduit box or cable trunking.

Access for maintenance or removal of lamps or other components shall be from below unless special provisions are made. The luminaires shall therefore be suitable and installed to facilitate this as far as is practicable.

Within the plant rooms, the layout of luminaires is shown as being regular. The Contractor, however, shall allow in his tender for any necessary rearrangement of these luminaires to suit a final equipment, pipe or ductwork layout.

The lighting installation shall be carried out using PVC insulated cables run within galvanised conduit generally concealed within the building finishes.

The cables shall be 2.5mm² (minimum) sized to suit the circuit loading; due allowance shall be made to ensure that the limit of volt drop for final sub-circuits set out in this Specification is not exceeded. In all instance a separate earth continuity conductor shall be installed with final circuits. Not more than one lighting or power circuit shall be bunched in the same conduit. At the completion of the works the whole installation shall be tested in accordance with the details indicated elsewhere in this Specification.

After the satisfactory conclusion of the tests the equipment shall be commissioned by switching on all lighting circuits and leaving them on for a period of 24 hours. At the completion of a continuous 24 hour run without fault the installation shall be retested to check any change in the insulation and earth resistance readings obtained at the original tests.

Any deterioration in the readings shall then be checked and corrected and the tests repeated until satisfactory results are obtained.

External Lighting

External lighting shall be supplied and installed as shown on the drawings. Control shall be by BMS and photo cells with override manual switching facility.

The wiring for external lighting points shall be carried out by CU/XLPE/PVC cables and by CU/XLPE/PVC/SWA for lighting poles.

Power System

From each distribution board designated for power services, the Contractor shall provide power circuits as required and as indicated on the drawings, and these circuits shall include, cable trunking, conduit, conduit accessories, cables, outlet units and all other materials and equipment necessary to complete the installation.

Points shall be provided for:

- a) General purpose 13 amp. Switch socket outlets
- b) Fused connections units (Switched spur units with indicators)
- c) Equipment isolators

d) Fan coil units

The Contractor shall allow in the rates for the final connection from the above outlets to the equipment indicated on the drawings, and as described elsewhere in this specification.

Where applicable; All water heaters shall be fed individually by a separate circuit from the relevant distribution board. In the case of larger heaters these are to be fed by three phase circuitry with a local isolator of the size called for., or from a mechanical control panel as indicated on the drawings.

Hand dryers – generally of 3 kW rating – shall be fed from a 16 Amp. MCB through a 20 ampere double pole local isolating switch.

General power circuits shall be wired using not less than 2.5mm² cables.

The final connection to single phase equipment shall be by a suitably rated flexible cable or cord to suit the equipment as indicated elsewhere in this Specification.

The final connection between the hard wiring and equipment in the case of 3phase equipment shall be by means of PVC sheathed flexible metallic PVC coated conduit complete with an independent earth continuity cable.

At the completion of the Contract Works the whole installation shall be tested in accordance with the details indicated elsewhere in this specification.

After the satisfactory completion of the tests, power equipment shall be connected and left in working order for a period of 24 hours.

At the completion of a continuous 24 hours run without fault, the installation shall be retested to check any change in the insulation and earth resistance readings obtained at the original tests. Any deterioration in the readings shall then be checked and corrected and the tests repeated until satisfactory results are obtained.

220.1.2.5 Derating

The current carrying capacity derated to 500C for all cables shall not be less than their respective current ratings appropriately derated and per IEE regulations 16th edition.

220.1.2.6 Jointing 11 kV, L.V. and Pilot Cables

1. General

All jointing shall be carried out to instructions of LOCAL CODE AND STANDARDS and the Engineer and only by approved certified Jointers. All jointing shall be carried out in accordance with the local code and standards Safety Rules.

All connections to lead sheaths shall be plumbed.

2. 11 kV Terminations

These shall generally be of the heat shrinkable type using compression connectors although occasionally compound filled terminations shall be required. Generally crossed cores shall be avoided.

3. Straight Joints

Intermediate joints shall be joined in the easiest way avoiding crossed cores.

4. Phasing joints

Phasing shall be in accordance with the instructions of local code and standards and the Engineer to obtain correct phasing. The joints shall be of the bituminous filled type using sweated ferrules.

5. Pilot Cables

These shall be jointed in accordance with instructions of local code and standards and the Engineer. The joints shall be resin filled type using compression connectors for straight joints and mechanical glands for terminations.

6. 600/1000 Volt Cables

All jointing shall be on a colour basis such that:

Core 1: Red phase

Core 2: Yellow phase

Core 3: Blue phase

Core 4: Neutral

7. For terminations heat shrinkable techniques and compression connectors shall be used.

8. For straight joints heat shrinkable techniques of joints using bituminous compound or resin shall be used at the discretion of the local codes and the Engineer.

9. For tee or branch joints bituminous compound or resin shall be at the discretion of local code and standards and engineer. Mechanical or sweated connectors shall be used as decided by local code and standards and the Engineer.

220.1.3 INSTALLATION

220.1.3.1 General

1 Installing cables:

- (a) Pull cable into position by hand, where possible using an adequate number of operative roller guides suitably positioned along cable length
- (b) Obtain approval of pulling cables by winch or similar appliance
- (c) When pulling by winch or the like, fit a suitable tension gauge into the haulage line between winch and cable. Pulling tension shall not exceed the limit recommended by the cable manufacturer
- (d) Do not allow cable to twist or rotate about its longitudinal axis
- (e) Lay 3 phase groups of single core cables in trefoil formation. If this is not possible obtain instructions
- (f) Install cables to allow any one cable to be subsequently removed without disturbing the remainder

- (g) Underground cable horizontal separation shall be a minimum of 150 mm
 - (h) Damaged cables shall be removed, unless the Engineer agrees to a repair.
- 2 Bending Radius: as large as possible and cable shall not to bend to a radius less than that specified in the relevant British Standard, local code and standards regulations or manufacturer's recommendation, whichever is largest.
- 3 Underground Cables in PVC-u Ducts:
- (a) Cables shall be installed in ducts where there is hard standing or vehicular passage. Ducts where there is vehicular passage shall be concrete encased
 - (b) cable duct size shall be as specified in the Drawings, to BS 3506 Class B or BS 4660
 - (c) Run cables at least 300 mm clear of other services, whether the latter run parallel or transversely to cable trench. Use pulling compound, or lubricant to avoid excessive stress on the cable, if required
 - (d) run cables below intersecting piped services, unless the cable would be at a depth exceeding 2 m, in which case seek instructions
 - (e) ducts shall not be filled with cables to more than 60 % of their capacity
 - (f) nylon draw cords shall always be left in ducts
 - (g) cable duct pits shall be provided at each change in direction and in any case at distances not exceeding 30 m
 - (h) ducts shall be suitably sealed with polyurethane foam or proprietary cable sealing arrangements if specified
 - (i) empty ducts shall be plugged with removable plugs
 - (j) ducts shall have a minimum diameter of 100 mm.
- 4 Direct Buried Cables:
- (a) LV and HV cables shall be laid at depths of 600 mm and 1000 mm, respectively, measured from the final finished ground level after all earthworks have been completed
 - (b) a 200 mm layer of dune sand shall be provided on the bottom of the cable trench for the cables to lie on. The cables shall be covered by a further 200 mm layer of sand before the trench is backfilled
 - (c) cables shall be protected by precast concrete tiles, as specified in clause 6.2.3.7 above, laid above the top layer of sand
 - (d) PVC warning tape shall be provided above the cables or concrete tiles, after partial backfilling and approximately 300 mm below finished ground level. All backfilling shall be with dune sand free from stones or other hard particles
 - (e) Concrete cable markers shall be provided at:
 - (i) every 20 m for straight runs

- (ii) road crossings
- (iii) joints
- (iv) deviations
- (v) entries to buildings
- (vi) entries to drawpits
- (f) The Engineer shall inspect the cable installation at each of the different stages above.

5 Cables above Ground:

- (a) protection shall be provided where mechanical damage is possible
- (b) unarmoured cables shall be protected by conduit, ducting or trunking
- (c) cables shall be protected from direct sunlight
- (d) cable spacings and layouts shall be as table 4A of BS 7671
- (e) cables shall be run at least 150 mm from other services.

6 Underground Cables in trenches

- (a) in areas of hard standing cables may also be installed in concrete or brick cable trenches with removable covers
- (b) cables may be laid in a single layer on the trench floor, otherwise they shall be supported on the sides of the trench on cable tray by cleats or ladders
- (c) cable spacings and layouts in the trenches shall be as table 4A of BS 7671
- (d) other services shall not be run in cable trenches.

7 Cable Supports:

- (a) cables shall be supported in accordance with the methods described in table 4A of BS 7671. Other methods shall be approved by the Engineer
- (b) cables shall be supported at regular intervals and at spacings a maximum of 400 mm for cleats for horizontal runs and 550 mm for vertical runs
- (c) vertical cable runs exceeding 100 m shall incorporate tension releasing sections
- (d) structured cable management systems or ladders shall be of G.R.P or galvanized steel cable supports shall be provided at 300 mm intervals
- (e) Cables:
 - (i) run on surface of walls ceilings. Where embedded, run in a PVC trough or conduit
 - (ii) run cables in square symmetrical lines. Where single core cables are run in groups, bend the sheaths at maximum 50 mm centres

(iii) fix surface run cables with saddles at maximum 300 mm centres.

8 Heat Resistant Cables:

- (a) in areas where a constant ambient temperature exceeding 55°C will occur, run all final sub-circuits and distribution circuits in heat resistant cable
- (b) make conversion from PVC cable to heat resistant cable with a fixed block connector housed and fixed into a conduit box or equal, except where the conversion of cable types emanate from a switch, ceiling rose or similar fixed connector accessory.

9 Flexible Cables:

- (a) flexible cable shall be kept to a minimum and concealed if possible
- (b) Mechanical retainment shall not depend on electrical connections.

10 Sealing Cables:

- (a) seal both ends of cables immediately after tests
- (b) seal MICC cables immediately after cutting to prevent hygroscopic action by the dielectric. All cables shall give an infinity test when tested on a 1000 volt Megger immediately, and 48 hours after sealing
- (c) seal aluminium sheathed cables with a metal cap plumbed to the sheath
- (d) seal plastic sheathed cables with a plastic cap embracing the wires and outer sheath
- (e) mark cable ends in accordance with the relevant BS.

11. Engineer will require to carry out inspections at the following stages:

- 1. Completion of excavations
- 2. Completion of bedding of trench prior to cable installation.
- 3. Cable installation
- 4. Completion of surround over cables and installation of cable tiles etc.
- 5. Upon completion of reinstatement.

12. The Contractor must not progress from one stage to the next of the above without the approval of the Engineer. The Contractor shall be responsible for arranging inspections to suit his programme of Works

13. Electrical Manhole & Covers

All type of electrical and ELV man holes shall be built with R.C.C structure of 200 mm thick and shall be provided with Heavy duty manhole covers and sizes as shown in the layout drawings where manholes are located in traffic areas, the Heavy duty cover shall be suitable for Heavy traffic flow and shall be subject to approval of the consultant Architect/Engineer at site.

220.1.3.2 Cable Trays

1 Generally:

- (a) install cables on trays in a single layer.
- (b) use purpose made straps or saddles to maintain cables in a neat regular disposition
- (b) secure cables with load bearing cleats securely fixed to the tray, where trays do not directly support the cables
- (c) space cleats, saddles and straps at maximum centres recommended in local code and standards regulations, as above, or by cable manufacturer
- (d) cable trays and installation shall be in accordance with Part 9 of this section, local code and standards regulations and BS 7671.

220.1.3.3 Spacing between Cables

1. High Voltage Cables

11,000 volt cables shall be laid with a horizontal spacing of 0.75m between centres and a minimum distance of 0.15m from trench wall.

Pilot cables shall be laid with a horizontal spacing of 0.14m from the associated main cable in case of multiple cables trenches pilot cables shall be laid between the power cables.

2. Low Voltage Cables

1000 volt main cables shall be laid with a horizontal spacing of 0.3 m between centres and with a minimum distance of 0.15 m from trench wall

3. High Voltage and Low Voltage Cables in Same Trench

Where 11,000 volt and 1000 volt cables are laid in the same trench, the spacing between the 11,000 volt and 1,000 volt shall be 0.75 metre.

Reduction of Spacing

Any reduction from above spacing can only be permissible for lengths of 10 m or less.

220.1.3.4 Trench Depth

1. High Voltage

For 11,000 volt cables the trench shall be 0.95 m deep.

2. Low Voltage

For 1,000 V main cables the trench shall be minimum 0.85 m deep

For 1,000 V service cables the trench shall be minimum 0.85 m deep. The above depth shall be co-ordinated with landscaping road details drawing.

3. Arrangements for Trenches with High Voltage and Low Voltage Cables Where 11,000 volt and 1,000 volt cables are to be laid along the same route a stepped trench shall be dug with the 1,000 volt cables laid inside i.e away from the road.

220.1.3.5 Cable Tiles

The Contractor shall provide and install:

- 1.1 Concrete cable tiles over all cables shown on the drawings.

Samples must be provided for approval by LOCAL CODE AND STANDARDS and the Engineer and satisfy a test of impact strength in accordance with BS 2484: 1985.

- 1.2 Cable tiles over all 11,000 volt cables manufactured from encycled polyethylene or similar complying with the following requirements:

Minimum thickness	:	12 mm
Length	:	1m
Width	:	24mm
Tensile	:	8.40 N/mm ²

(BS2782:1976 Method 20C)

- 1.3 The tiles shall be marked as specified. The cable tiles must be supplied complete with any pins, pegs or other devices for jointing tiles together. Samples must be supplied to local code and standards and the Engineer for approval prior to use.

220.1.3.6 Removal of Existing Cables

1. The Contractor shall liaise directly with local code and standards regarding the removal of any existing cables and shall not, under any circumstances, commence removal of cables until local authorities have verified such apparatus as being redundant. Removal of cables shall only be carried out in the presence of the Engineer.

220.1.3.7 Ducts

Ducts are to be supplied by the Contractor. They shall be of the following type:

Material - High impact resistance PVC

Internal Diameter - 150 mm or 100 mm as specified

Minimum wall thickness - 3.6 mm (for 150 mm ducts) or
- 2.4 mm (for 100 mm ducts)

Samples shall be provided for approval by the Engineer prior to use.

220.1.3.8 Quarry Scalping

1. Shall comprise of quarried limestone materials having particle sizes varying from 5 mm down to dust with a homogenous mixture of all particle sizes.
2. The materials shall have specific mechanical and thermal resistive qualities as defined below:
 - a). Thermal Resistivity

The material shall be subject to a 90 % compaction, using the optimum amount of water. After subsequent drying, such that the water content does not exceed 2% of the weight of the sample the thermal resistivity of the material shall not exceed 2.0 C M/Watt

- b). Mechanical Qualities

The material shall have mechanical qualities that meet the requirements of the local regulations and standards.

220.1.3.9 Methods of Cable installation

The arrangement of cables and the methods of laying shall be approved by The Engineer. Cables shall be either laid direct in the ground, with protective covers, drawn into the pipes or ducts, laid in troughs or on racks or supported on trays or cleats as may be detailed on the drawings or be required by The Engineer.

Where cables are installed in areas or locations that may be subjected to direct sunlight, the Contractor shall provide suitably approved sun covers or protection for the cables.

220.1.3.10 Excavations of Trenches for Direct Buried Cables

The exact location route and construction of each trench shall be approved by The Engineer. Trenches shall be kept as straight as possible and each trench shall be excavated to an approved formation and dimension and shall have vertical sides which shall be timbered where necessary so as to avoid subsidence and damage to cables.

The bottom of each trench shall be firm and of smooth contour.

Where trenches pass from a footway to a roadway or at other positions where a change of level is necessary, the bottom of the trenches shall rise or fall gradually, and to the Engineer approval. Where required; The Contractor shall provide all pumps and appliances required to dispose off water within trenches to prevent any detrimental effect on cable or other materials to be laid in the trenches.

Unless otherwise agreed, provision shall be made during excavation for reasonable access of persons and vehicles to property or places adjacent to the route. This provision shall be maintained until restoration has been completed.

When the excavation for trenches have been accurately executed, notice shall be given by the contractor to The Engineer. Laying of cables or building of structures shall not be started until the Contractor has obtained the Engineer sanction to proceed with the work.

The material excavated from each trench shall be so placed as not to prevent nuisance or damage. Where this is not possible the excavated material shall be removed from the site and returned for refilling the trench on completion of cable laying without additional cost to the Client. Surplus materials shall be disposed of by and at the cost of the Contractor.

Filling in of trenches shall not be commenced until The Engineer has inspected and approved the cables and accessories in-situ.

220.1.3.11 Cables Laid Direct in Ground

The Contractor shall lay the cables direct in the ground in the following manner.

200mm of graded and washed builder's fine sand shall be placed to form a bed for the cables. After the cables have been laid, they shall be covered with additional riddled sand well punned over and around the cables to a level of 200mm above the top of the upper most cable.

Mechanical punters shall not be used for this work.

On top of the sand layer the Contractor shall lay cable marker tapes for each cable. The tape shall be yellow and marked "Danger Live Cables". If mechanical protection is indicated, cable tiles shall be carefully centred over and 200mm above the cables forming each circuit. Each cover shall be interlocked with the adjacent covers throughout the length of the cable.

Where in the opinion of The Engineer, the soil on the site is unsuitable for backfilling, the Contractor shall arrange for the importation of suitable material.

Where more than one horizontal layer of cable is laid the level of the upper layers of cable shall be gauged from the level of finished bottom of the trench and marked on the side of the trench at frequent intervals before the installation of the lower layers, to ensure that the correct vertical spacing is maintained.

Where three single-core cables are laid direct in the ground and form one three-phase circuit, they shall unless otherwise stated, be laid touching one another in triangular formation, the apex of the triangle being uppermost.

In order to maintain a triangular formation the three cables shall be tied together with tarred twine or by other approved means at intervals of 1.5 metres.

Unless otherwise approved the minimum distance between the centres of three-core power cables or three-phase groups of single power core cables shall be 0.45 metres.

Unless otherwise approved, auxiliary control cable shall be laid under the same covers as the power cables and there shall be at least 200mm of riddled sand between the two types of cables. After any cable has been laid, no sharp metal tools such as spades or fencing stakes shall be used in the trench or placed in such a way that they may fall into the trench. Rollers used during the laying of cables shall have no sharp projecting parts liable to damage the cables.

220.1.3.12 Cables Drawn into Ducts

The Contractor shall remove any loose material from the ducts, and prove them by drawing through a mandrel of slightly less diameter than the duct, immediately before pulling in the cables. Any lubricant used shall have no deleterious effect on the cables.

The Contractor shall supply and install suitable plugs for sealing all ducts or pipes, after the installation of cables.

Empty ducts or pipes shall be sealed by the use of solid plugs and all plugs shall prevent the ingress of both water and vermin.

220.1.3.13 Cables Supported on Racks, Trays etc.

All single core and multi-core power cables shall be fixed by cleats or saddles, spaced in accordance with the requirements of IEE Regulations. Power cables, having conductor areas of 162mm² and less shall be installed in trays but segregated from other cables on the same tray by

a space of 30mm.

All control cables shall be installed on trays.

All cables shall be run with particular regard to neatness of appearance. Multiple runs shall be arranged so that cables entering or leaving the run do so in a logical manner.

The Contractor shall supply the whole of the cable supporting steel work including all racks, trays, cleats clamps, nuts, bolts, washers, fixings and other items to complete the installation of cables supplied in this Contract.

All supporting steelwork shall be hot galvanised after manufacture in accordance with BS 729 and shall be to the approval of The Engineer.

Tender drawing shows main cable routes only.

The Contractor shall make due allowance for the preparation of all detailed routing and steel work drawings, necessary to enable The Engineer to give his approval of all main and subsidiary routes before installation commences. Adequate allowance shall be made in the designs for additional cabling required for known future extensions plus 20% spare capacity.

220.1.3.14 Installation

The cable shall be installed either on surface directly or recessed in adequately sized conduits / trunking with wide bend turnings. The bending radius shall be maintained minimum 8 times outer diameter.

Ferrules supplied by the manufacturer shall be fitted immediately after removal of sheath so as to prevent any damage to core insulation.

END OF SECTION

SECTION 1600-240

WIRING ACCESSORIES AND GENERAL POWER

WIRING ACCESSORIES AND GENERAL POWER

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240.1 Wiring Accessories and General Power

240.1.1 General

240.1.1.1 General Reference

- 1 The work of this Section is integral with the whole of the Project Documentation and is not intended to be interpreted outside that context.
- 2 Co-ordinate the work with all other services affecting the work of this Section.
- 3 Related Parts and Sections are as follows:

This Section	Part 1	General Provisions for Electrical Installation
	Part 6	Cables and Small wiring
	Part 7	Conduits and Conduits Boxes
	Part 8	Trunking

240.1.1.2 References

- 1 The following standards are referred to in this Part:

BS 88 HRC Fuses

BS 546 Specification Two pole and earthing-pin plugs, socket-outlets and socket outlet adapters

BS 800 Specification for radio interference limits and measurements for household appliances, portable tools and other electrical equipment causing similar types of interference

BS 1363 3A Plugs, Switched and Un-switched Socket Outlets and connection units BS 3456 Specifications for safety of household and similar electrical appliances

BS 3676 Part 1 Switches for household and similar fixed electrical installations

BS 4177 Cooker Control Units rated 30 Amp. and 45 Amp. 250 volts single phase supply

BS 4343 Industrial Plugs, Socket Outlets and Couplers

BS 4662 Boxes for enclosure of electrical Accessories

BS 5419 Fuse Switches and Switch Fuses

BS 5733 General requirements for electrical accessories

240.1.1.3 Description OF Work

- 1 This Section shall include all labour, materials, equipment, appliances and accessories necessary for the complete performance of all switches, socket outlets etc. In accordance with the Specifications and Drawings.

240.1.1.4 Submittals

- 1 Submit shop drawings, equipment list, relevant samples etc. as mentioned under Section Part 1.

240.1.2 PRODUCTS

240.1.2.1 General

- 1 All individual items of materials shall be of the same make throughout the Project unless specifically approved by the Engineer.

240.1.2.2 Outlet Boxes

- 1 Outlet Boxes:
 - (a) galvanized one piece pressed steel, sizes and designs shall suit devices to be fitted
 - (b) In all hazardous areas specified and/or shown on drawings: explosion proof.
- 2 Outlet boxes mounted externally or in damp locations shall be totally sealed to ensure water tightness.

240.1.2.3 Switches

- 1 Lighting Switches
 - (a) To BS 3676
 - (b) To be rated 15 or 20 amps depending on connected load, as stipulated in the local code and standards regulations
 - (c) Recessed with concealed conduit, surface pattern elsewhere
 - (d) Quick make and break type
 - (e) Single pole, double pole, one way, two way or intermediate as indicated
 - (f) Surface mounted switches to be metal clad type in MV, transformers, LV , Generator , mechanical & electrical plant Rooms.
 - (g) Flush mounted switches to be of the grid fixing type with white plastic finish in all areas.
 - (h) Switches shall be certified for AC-23A duty.
- 2 Waterproof Switches:
 - (a) To be watertight IP 56 or as indicated in the Project Documentation
 - (b) To be made of poly-carbonate master seal type for indoor application in damp and wet areas carpark area, plant rooms, pump room, etc.

- (c) to be metallic suitable for AC-23A duty and have sunshades fitted where exposed to direct sunlight.

3 Switch Plates

- (a) where two or more switches are grouped together and connected to the same phase, multi-gang devices and common plates shall be used.

4 Double Pole Switches:

- (a) the double pole switches shall be with neon indication lamps and shall be rated 20, 30 or 45 Amps. as indicated on the drawings
- (b) the face plate shall be of matt chrome, unless specified otherwise in the Project Documentation and shall be engraved 'WATER HEATER', 'WATER COOLER' etc. as required.
- (c) switches shall be certified for AC-23A duty.

5 Push switches for lighting contactor control:

- (a) push to make momentary contact switch
- (b) suitable for inductive load
- (c) surface mounted type shall be either poly-carbonate, metallic, protected to IP 56 or as indicated in the Project Documentation
- (d) where two or more switches occur in one position they shall be contained in one case and each shall be appropriately labelled to indicate its function
- (e) switches shall be certified for AC-23A duty and contactors shall be certified for AC-3 duty.

6 Dimming Switches:

- (a) where indicated on the Project Drawings, dimming switches shall be provided, complying with BS 5518
- (b) dimming switches shall be interference suppressed to conform with BS 800
- (c) all dimmer units shall be sized to give a 40% margin above the connected load.
- (d) switches shall be certified for AC-23A duty

240.1.2.4 Ceiling Roses for lighting installations

- 1 Ceiling roses shall be of the all insulated type conforming to BS 67 with a white finish.
- 2 Ceiling roses shall be provided with insulated terminals for the switched live, neutral and protective conductors; loop-in facilities shall be provided.
- 3 Plug-in ceiling roses shall be used in this project.

240.1.2.5 Socket Outlets

- 1 General purpose Socket Outlets:
 - (a) to BS 1363
 - (b) 3 rectangular pin (2P+E) shuttered, with combined switch, rated 13A, 250 V
 - (c) to be supplied with plug complete with fuse
 - (d) Neon indicator lamp.
- 2 15A Socket Outlet:
 - (a) to BS 546
 - (b) 3 round pin (2 P + E) shuttered switched pattern complete with plugs.
 - (c) Neon indicator lamp.
- 3 Weather proof Sockets:
 - (a) 13A Sockets: to BS 1363
 - (b) 3 rectangular pins, switched type to be complete with weather proof plugs
 - (c) plugs: 13 Amps
 - (d) sockets: fused type with single pole cartridge fuse link of same rating as plug
 - (e) sockets and plugs:
 - (i) to have minimum IP 56 grade protection
 - (ii) housing parts: brass or pressure die-cast finished in grey hammered stove enamel or poly carbonate master seal type as per Engineer approval.
 - (iii) plugs:
 - cable grips shall have rubber compression rings
 - there shall be rubber gasket between plug and socket to ensure weather tightness.
 - (f) sockets shall have screw on caps that close tight on socket when plugs are not inserted for metal clad (die cast) type.
- 4 Socket Outlet Plates:
 - (a) socket outlet face plates shall be of the white plastic finish in all areas, metal clad type in M.V, H.V , generator, mechanical and electrical plant rooms, poly carbonate "similar to master seal type-MK-UK" in transformer room, carpark area, plant room, pump rooms and in exposed to sunlight areas.
- 5 Industrial Sockets:
 - (a) Combined Socket
 - (i) to be a combined unit comprising two sockets, rated 16A, 220 or 230 or 240V, 1 phase and 32A, 380 or 400 or 415V (as applicable), 3 phase

- (ii) to be equipped with 16A SP and 32A TP MCBs, or as indicated in the Project Documentation
- (iii) three phase socket to be 5 pin type, single phase socket to be 3 pin type
- (iv) plugs of the same manufacturer to be provided
- (v) sockets and plugs to conform to BS 4343
- (vi) to have minimum IP 55 ingress protection.
- (b) plugs and sockets for hazardous area:
 - (i) to be suitable for zone 0, zone 1 or zone 2 applications, as relevant.
 - (ii) to conform to IEC 309-3
 - (iii) to be corrosion resistant
 - (iv) ingress protection to IP 66.

240.1.2.6 Shaver Socket Outlets

- 1 All shaver socket outlet units shall comply with BS 3456 and IEC 335.
- 2 Shaver units shall be flush pattern with white moulded insert in matt chrome plate engraved 'Shaver Only' and be suitable for installation in bathrooms, incorporating a double wound isolating transformer to provide an earth free supply.
- 3 Units shall incorporate primary winding circuit protection in the form of a self-resetting thermal overload device.
- 4 Units shall incorporate an 'ON/OFF' switch with red neon indicator together with a selector switch for 20 VA load capacity at 240 Volts and 115 Volts
- 5 Units shall incorporate two pin shuttered outlet configuration and have terminals to accept 2.5 mm² conductors.
- 6 Unit outlet boxes shall be a minimum of 45 mm deep, rustproof by galvanising of equal finish and complete with a brass earthing stud secured to the back of the box.

240.1.2.7 Cooker Control Units

- 1 Cooker control units shall incorporate a 32 Amp. double pole switch and 13A, 3 pin switched socket outlet and neon indicator lights for both cooker and socket
- 2 The cooker control unit shall be flush mounted and matt chrome finish.

240.1.2.8 Disconnect Switches and Switch Fuses

- 1 Generally
 - a) to be metal clad with front operated handles interlocked with switch fuse case to prevent opening switch in the "ON" position
 - b) switch shall have "ON/OFF" indication and provision for locking in "OFF" position
 - c) utilisation category AC 23A
- 2 Fuse switch and switch fuses
 - a) to BS 5419
 - b) fuses: to BS 88 bolted type, class Q1, certified for 415V and AC 80 Duty, rated as indicated
 - c) fused switch carriages: withdrawable type
 - d) fuse switches: ASTA certified to 50 KA.
- 3 Disconnect switches
 - a) same design as switch-fuses, with solid copper links in place of fuses
 - b) single pole and neutral, or triple pole and neutral
 - c) ratings, as indicated.

240.1.2.9 Fused Connection Units

- 1 Single phase fused connection units shall be switched, shall comply with BS 5733 and shall be fitted with a fuse complying with BS 1362 with a rating as shown on drawings.
- 2 All fused connection unit shall be fitted with a neon indicator.
- 3 Live contacts shall not be exposed under normal operating conditions when replacing a fuse.
- 4 Single phase fuse connection units in electrical room, M.V, H.V , generator, mechanical and electrical plant rooms, shall be surface mounted, metal clad and shall comply with BS 1363 and poly carbonate (similar to MK-UK /master seal type) in carpark, plant rooms, pump rooms & exposed to sunlight areas.
- 5 The type of fused connection unit, particularly relating to the flex outlet, shall be authorized by the Engineer prior to the ordering of accessories.

240.1.2.10 Junction, Pull and Terminal Boxes

- 1 The Junction Box shall be completed with a terminal block suitable for connecting up to 10 mm² copper conductor (phase, neutral and earth) and an all insulated moulded white cover plate with removal covers.
- 2 The cover plate shall be raised for connecting outgoing cable.

240.1.2.11 Timer

- 1 Timers shall be electronic type, unless specified otherwise in the Project Documentation.
- 2 Timers shall be suitable for operation from supply voltage of 220 or 230 or 240V (as applicable), 1-phase, 50Hz system.
- 3 Timer output contacts shall be suitable for both a.c. and d.c. control circuits. The contacts shall be suitable for duty of AC-2 or DC-3 utilisation category. The rating of output contacts shall be co-ordinated with the application requirements.
- 4 Timers shall be provided with 2 independent timing scales with sets of change-over output contacts:
 - a) 10 200 seconds
 - b) 0.10 20 seconds
- 5 ON/OFF indicator shall be provided to monitor the circuit status.
- 6 Timers shall be either:
 - a) delay on energisation or
 - b) delay on de-energisation type, as per the application requirements

Upon supply of rated voltage to the input terminals, the timer shall start, the output relay remains in rest position. After the set time, the output relay pulls in.

The relay resets after the input supply has been cut-off.

- 7 Timers shall be suitable for minimum 10 million operations.
- 8 The timer shall require a pozi-drive screw driver for changing of the settings.
- 9 Degree of protection shall be minimum IP 20.

240.1.2.12 Time clocks

- 1 Time clocks to control circuits depended on time and hours of the day, may be either
 - a) Synchronous motor operated, or
 - b) Quartz controlled motor operated, as per Project Documentation.
- 2 Time clocks shall be suitable for operation from supply voltage of 240V, 1-phase, 50Hz system.
- 3 Output contacts shall be suitable for both AC and DC control circuits. The contacts shall be suitable for duty of AC-2 or DC-3 utilisation category. The rating of output contacts shall be co-ordinated with the application requirements.
- 4 The no. of output contacts and the duration of contact closing shall be decided as per the application requirements.
- 5 Time clocks shall be provided with a time dial setting for 24 hours and 7 days program.

- 6 Each time clock shall be provided with a minimum running reserve energy for 1 day.
- 7 Accuracy of clocks shall be better than 1 second per day.

240.1.2.13 Hand Dryer

The hand dryer shall be auto pilot hand dryer feature convenient hands - free operation type equipped with an electronic sensor to automatically turn the dryer on when hands are placed under the nozzle.

Auto pilot shall be provided to turn the dryer off when user removes his hands, this to ensure saving of the energy cost.

The dryer shall not stop until user is satisfied that his hands are dry, the dryer shall operate as long as user needs it.

The hand dryer shall be surface type with cover features and concealed air intake grille, corrosion resistant cast iron cover with vitreous enamel finish. Colour to match location and interior design finish schedules and per the Engineer approval.

The hand dryer cover shall be vandal resistant to absorb heavy impact without scratching or denting.

The hand dryer shall be suitable to A.C. supply, 220 or 230 or 240V (as applicable), 50Hz equipped with 2000 watt heating element.

240.1.2.14 Connection Units (Fuse Spur Outlets)

Connection units required for the connection of fixed appliances shall be similar in style and finish as that specified for the lighting switches for the areas concerned. They shall be of a pattern conforming to the latest British Standard.

The units shall be suitable for flush or surface mounting and be installed as described for the socket outlets.

The minimum requirements to be provided on the plate shall be for a switch, fuse unit and indicator light. Based on the detailed requirements a cable egress hole shall also be provided.

The mounting height for connection units shall be in accordance with the Engineer requirements and instructions.

Connection units installed at external environmental conditions shall be master seal type weather proof.

240.1.2.15 Triple Pole Switches

The switches for 3 phase power supply in tenancy area for Kitchen equipment shall be triple pole 30 or 45 Amp. Rating based on the load current and flush mounting type the switches shall have indicating lamps with finishes to match with lighting switches for the area concerned.

240.1.3 Connections to Fixed Equipment

Connections to fixed equipment such as water heaters etc., single or three phase shall be carried out using 300/500 volt EPR insulated CSP sheathed CMA flexible cords to BS 6500 and BS 6007.

Special regard shall be made to the latest regulations of IEE detailing the method of connection to fixed equipment and the positioning of switches and outlet plates.

240.1.4 INSTALLATION

240.1.4.1 Mounting Heights

- 1 The mounting heights of wiring accessories shall be as stipulated in the local code and standards Regulations, or as otherwise approved by the Engineer.

240.1.4.2 Installation of Outlet Boxes

- 1 Location of Boxes:
 - (a) determine exact location of boxes on site and obtain the Engineer's approval before commencing installation
 - (b) make allowance for overhead pipes, ducts, variations in arrangement, thickness of finish, window trim, panelling and other construction when locating boxes.
- 2 Fixing:
 - (a) fix outlet boxes securely
 - (b) fix exposed outlet boxes to permanent inserts or lead anchors with machine screws.

240.1.4.3 Installation of Switches

- 1 Lighting Switches:
 - (a) located at the strike side of the door, approximately 150 mm from the edge of door frame
 - (b) plates shall be installed with all four edges in continuous contact with finished wall
 - (c) plates shall be installed with an alignment tolerance of 1.5 mm
 - (d) all switch assembly louvered plates shall have their earthing terminal connected to the earth terminal attached to the switch box by an insulated 2.5 mm² protective conductor.

240.1.4.4 Installation of Junction, Pull and Terminal Boxes

- 1 Generally:
 - (a) junction, pull and terminal boxes where indicated and where required to facilities pulling of wires and cables and connection of future appliances
 - (b) locate boxes as inconspicuously as possible, but accessible after work is completed.
- 2 Pull Boxes:
 - (a) fix at maximum 10m spacing and to limit the number of bends in conduit to not more than two 90° bends.

240.1.4.5 Testing

- 1 Test all switches, socket outlets etc. for correct polarity and continuity of conductors in the presence of and to the entire satisfaction of the Engineer.
- 2 Carry out live phase to earth loop impedance tests at all switches and socket outlets with an approved earth loop impedance tester to the entire satisfaction of the Engineer. Ensure that all device plates have satisfactory earth continuity to the protective conductor system.
- 3 Test all socket outlets for instantaneous tripping of associated distribution board current operated earth leakage circuit breaker using testing equipment, approved by the Engineer.

END OF SECTION

SECTION 1600-260

SECONDARY DISTRIBUTION BOARDS

Secondary Distribution Boards

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260.1 Panel Boards

260.1.1 Scope

Provide labour, materials, equipment and services, and perform operations required for installation of basic electrical and methods and related work as indicated on the drawings and specification herein.

Work Included: The work shall include all distribution pane-boards mentioned on drawings and diagrams, and supplying lighting, socket outlets and power circuits.

Quality Assurance

Materials and equipment shall conform to the latest edition of reference specifications specified herein and to applicable codes and requirements of local authorities having jurisdiction.

Electrical Code Compliance:

Comply with requirements of the applicable electrical code, in particular, IEC 60947- Part 1 and 2 for industrial LV installations and IEC 60898 for domestic LV installations.

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Submittals

Submit the following in accordance with the requirements specified under "submittals" in the related Section.

Product Data: Submit manufacturer's data on panel-boards and enclosures, including dimension, interiors, certifications, etc..

Sequencing and Scheduling

Coordinate installation of panel-boards and enclosures with installation of wires/cables, electrical boxes and fittings, conduit and cable tray.

260.2 Materials

260.2.1.1 General

- a. Panel-boards shall conform to the corresponding schematic diagrams.
- b. Except as otherwise indicated, provide panel-boards, enclosures and ancillary components, of types, sizes and ratings as indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product for installation; equip with proper number of devices as required for installation. Where types, sizes, or ratings are not indicated, comply with applicable electrical code and established industry standards for those applications indicated.
- c. All panel-boards shall be the product of one manufacturer, unless otherwise noted on drawings.
- d. Panel-boards shall be designed and arranged to give maximum reliability in service, having regard for speed and safety during installation and maintenance.
- e. All equipment shall be rated to withstand, without damage, the maximum fault level at the point in the distribution system at which it is installed.
- f. Where interrupting ratings of circuit breakers are specified, or shown on drawings to be based on integrated series short ratings, the series combination shall have been tested in accordance with standards. Manufacturer shall certify that equipment furnished is adequately rated in the selected configuration.
- g. All panel-boards shall be selected with 20% spare capacity.

260.2.1.2 Enclosures

- a. Provide enclosures which are fabricated by same manufacturer as panel-boards, which mate and match properly with panel-boards to be enclosed.
- b. The panel-boards shall be free standing or wall mounting type, manufactured from 1.6 mm steel sheet, with rigid and robust form and, if recessed manufactured from plastic materials, self extinguishable.
- c. External surfaces, corners and edges shall be smooth to avoid the collection of dust and to facilitate cleaning.
- d. Protection index shall not be less than IP 21, with dust, damp and vermin protection. Vermin proof ventilation holes shall be provided for natural air circulation.
- e. Cable glands and entries shall be provided in accordance with the protection index.
- f. Protective screwed front plates, easy to remove, shall be provided.
- g. All access doors and covers shall be rigidly constructed to avoid deflection and bending, and to prevent from ineffective sealing by tightening of the retaining screws. Doors shall be sealed with an expanded gasket that shall be fitted to the inside perimeter face. Door fasteners shall be screwed.

- h. The overall height shall not exceed 2000 mm, unless otherwise stated.
- i. Lifting rings if needed shall be provided at suitable strengthened locations on the top.
- j. The enclosure finishing, internally and externally, shall be carried out with thermal polymerized polyester-epoxy powder coating, grey colour, or approved equal.
- k. Enclosure shall comprise vertical wiring channels, with removable covers.
- l. The panel-board and included devices and components shall be arranged to withstand, without damage, the effects of any fault current up to and including the maximum short circuit current.
- m. The panel board shall be finger safe construction with short circuit capacity not less than 10 KA/ 1second.
- n. All enclosures, including the main panel-boards, will have the same key, similar to "405" from "Merlin Gerin" or equivalent.

260.2.1.3 Switches

Where distribution panel-boards are specified to be complete with a switch, the switch shall be double-pole for single-phase boards and 4 poles for three-phase boards. Main switch shall be with external handle, accessible for switching off from the front side of the panel-board if door is metallic, otherwise on right or left side.

The switch shall be in accordance with the applicable standards, and be capable of carrying for 3 seconds, the fault current equivalent to the three-phase short circuit of the system specified, modified only in duration and magnitude by the largest protective device in the feeder circuit to the distribution panel-board.

The switch shall be fitted inside the panel-board enclosure.

If a panel-board is inside an enclosure, it will be equipped with an external lever.

260.2.2 Miniature Circuit Breakers

- a. All miniature circuit breakers shall be modular plug-on 10 KA / 1second and shall have trip settings and number of poles as indicated of the drawings. All circuit breakers shall have their amperes trip rating clearly marked and visible.
- b. Breakers shall have quick-make, quick-break, toggle mechanism, and shall provide positive trip-free operation on abnormal overloads. Stationary and movable contacts shall be adequately protected with effective and rapid arc interruption.
- c. Modular circuit breakers shall include a neutral pole, for sectioning only, not equipped with a tripping unit.
- d. Each phase pole of the Breaker shall be equipped with an inverse time delay thermal over-current trip element and magnetic instantaneous over-current trip element for common tripping of all poles for multiple pole breakers. Multiple pole breakers shall have a single handle mechanism. Automatic tripping shall be indicated by the breaker handle assuming a clearly distinctive position.

- e. They shall be installed on rails, readily removable to facilitate installation and wiring.
- f. All contact on the busbar side shall be fully shrouded to prevent accidental contacts.
- g. They shall be chosen in order to withstand the fault current level, and the consumed load current increased with 20% of spare capacity. The nominal rated currents of the circuit breakers shall be derated to the environmental conditions.
- h. Where indicated on the related diagrams, modular circuit breakers shall be equipped with a residual current protection device, with the adequate rating current. In particular, circuit breaker shall be equipped with a 30mA differential when supplying the following circuits:
 - 1. All socket outlet circuits.
 - 2. All lighting and power circuits in damp premises.
- i. Where specified, air conditioning circuit breakers shall be fitted with shunt trip release coil connected to a terminal block enabling the tripping of the circuit from the Fire Safety System.

260.2.3 Earth leakage circuit breakers

Current operated earth leakage circuit breakers (RCBO) shall comply with IEC 61009. They shall consist of a current transformer, tripping coil with contact assembly, main supply contacts, ON / OFF switch, Test button and trip free mechanism, all mounted on a robust board of insulated material. It shall be suitable for the cables to be connected.

The sensitivity of the breakers shall be such that they are capable of detecting earth leakages of 30 mili-amps and the operating time shall not exceed 20 mili-seconds. The fault level shall not be less than 10 KA. Tripping time shall be unaffected by temperature changes and it shall not be possible to hold the trip mechanism closed under fault conditions.

The windings and coils shall be suitably tropicalised for operating in a relative humidity of 100%. All contacts shall be of robust construction and be of non-welding, self-wiping and self number of poles and the rated current shall be as detailed on the drawings and the terminal sizes -aligning type designed for a minimum of 10,000 switching operations.

260.2.4 Power and Lighting Contactors

- a. All power and lighting contactors shall be supplied for the current rating specified.
- b. Power Contactors shall be electrically operated by a dual-acting, single-solenoid mechanism.
- c. Contacts shall be of the self-cleaning type. The design shall be such as to prevent welding-in.
- d. Lighting Contactors:
 - 1. The Remote Control Lighting Contactor shall be electrically operated by a dual-acting, single-solenoid mechanism that is inherently interlocked and mechanically held in both the open and closed positions. The main contacts shall be power driven in both

directions. Positive locking of contact positions shall not be dependent on gravity, hooks, latches or semi-permanent magnets.

2. The remote control lighting contactor shall be capable of operating in any position. Provisions shall be incorporated for manual operation during inspection and maintenance.
3. The remote control lighting contactor shall be in accordance with BSI Standards. Main contacts shall be continuous duty rated 16A minimum to 250V AC, 50 Hz and marked for ballast lighting (electric discharge lamps), tungsten and general-purpose loads. For fluorescent lighting applications, they shall be suitably derated according to the number of lamps connected to the circuit.
4. The remote control lighting contactor shall be provided with clamp-type, self-rising terminal plates for solder connection of line, load and control conductors. Terminals shall accept a wire range 4 mm².
5. The number of poles, on a single remote control lighting contactor, shall be provided as indicated on the diagrams.
6. Wiring
 - a. All power and control cables issued from the panel-boards, shall be connected to terminal blocks.
 - b. Wiring between the panel-board components and the terminal blocks compartments shall be installed in wiring channels, attached with plastic straps, with maximum interval of 30 cm.
 - c. Wiring shall be executed using single pole conductors with nominal voltage of 700V for power and auxiliary circuits. Power cable cross-sections shall be selected as for circuit cross-section cables.
 - d. Cable colours shall be standard with terminal markings for auxiliary circuits and standardized markings for power circuits.
 - e. Internal connections shall be made using pre-insulated crimped lugs or end-fittings which correspond to the cross-section of the cable. In no case shall cables be unprotected where they come into contact with the edges of metalwork.

260.2.5 Identification

- a. Accurate schematic diagrams shall be provided at the completion of the works for all panel-boards. Each diagram shall be placed in a plastic envelope, fixed securely to the inside face of the corresponding panel-board hinged door.
- b. Provide nameplate, in accordance with the related section, riveted to the front side face of the hinged door.
- c. Each circuit breaker shall be marked by means of Dilophane labels, fixed on the protective front plates, and mentioning the number and the destination of the corresponding circuit.
- d. All wires shall have circuit identification ring labels at both ends.

260.2.6 Grounding

- a. Provide equipment grounding connection as specified in the related Section for panel-board enclosures.
- b. All non current carrying metalwork shall be effectively and securely bonded to ground system. All equipment metalwork including adjacent cable tray shall be bonded together by means of stranded copper tape of minimum size 25mm x 3mm. All incoming and outgoing ground continuity conductors shall be effectively and securely bonded together and to the ground system.
- c. Where the tape is fixed to equipment, effective electrical contact shall be achieved through screws and bolts.

260.2.7 Panel-board Interiors

- a. Assembly of branch circuit units and electro-plated buses on a back pan arranged to permit removal of any unit without disturbing adjacent unit.
- b. Main terminals shall be equipped with solder-less pressure indent type connector with means to prevent swivelling.
- c. Provide appropriate hardware ready to receive future switch and circuit breaker with blank plates for circuits marked "SPACE".

Each panel-board will be designed with 30% of space plus the spare (including the main panel-board).

260.2.8 Insulation Control

Panel-boards destined for emergency lighting, shall be provided with devices allowing the measurement of the ground fault current.

260.2.8.1 Workmanship

260.2.8.2 Examination

Examine conditions at the job site where electrical work is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

260.2.8.3 Preparation

- a. Examine the Contract Drawings and specification in order to insure the completeness of the work required under this Section.
- b. Verify measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this Section with the work related trades, so as no to delay job progress.

- c. Provide templates as required to related trades for location of items.

260.2.8.4 Installation

- a. Install panel-boards and enclosures as indicated, in accordance with manufacturer's written instruction, applicable requirements of the applicable electrical code and in compliance with recognized industry practices to ensure that products fulfil requirements.
- b. Mount panel-boards on walls at least 2 cm from wall and do not block vertical flow of air behind cabinets.
- c. Close unused enclosure openings.
- d. Mount top of panel board 1.8m above finished floor.
- e. Tighten connections and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.
- f. Fasten enclosure firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
- g. Provide properly wired electrical connections for panel-boards within enclosures.
- h. Type panel-board's circuit directory card upon completion of installation work.
- i. Grounding: Provide equipment grounding connection as specified in the related Section for panel-board enclosures.

260.2.8.5 Demonstration

- 1. Subsequent to wire and cable hook-ups, energize panel-boards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.
- 2. Test panel-boards as specified in the related Section.

260.2.8.6 Adjusting and Cleaning

- 1. Adjust operating mechanism for free mechanical movement.
- 2. Touch-up scratched or marred surfaces to match original finishes.

END OF SECTION

SECTION 1600-410

EARTHING AND BONDING

EARTHING AND BONDING

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410.1 EARTHING AND BONDING

410.1.1 General

Earthing and bonding shall comply with IEE, CP 1013 Section D, JEPCO and the MOPW&H Regulations.

410.1.2 Earthing

The Contractor shall provide substantial earthing lugs or boxes on all distribution boards, isolators, starters, control panels; lighting control boxes etc. The bonding from these lugs or bosses to an earth system shall be part of this Contract.

Bare earth tapes fixed to walls and structures, shall be clamped on to stand-off brackets to afford a clearance of 5mm.

Connections to the earth tape shall be clamped or revetted and soldered.

410.1.3 Main Switchgear Earthing

At all main switchgear positions an earth conductor consisting of copper strip having a minimum cross sectional area of 300 mm² shall be provided and all equipment including the metal sheath and armouring of cables, the metal cases of all switches and distribution boards and metal cases of all equipment directly bonded to it.

Where a copper strip is fixed to the building structure, it shall be done by means of purpose made brass or poly-propene saddles, using purpose-made plugs and clamps. Fixings requiring the drilling of holes through the strip shall not be accepted.

Joints in copper tape shall be tinned before assembly, revetted with a minimum of two copper rivets and sheathed solid.

Where holes are drilled in the earth tape for connection to items of plant the effective cross sectional area of the connection shall not be less than that required to comply with IEE Regulations.

Bolts, nuts and washers for any fixing of the earth tape shall be brass of the high tensile grade, or where liable to corrosion, they shall be bronze.

410.1.4 Earth Electrodes

Unless otherwise specified, earth electrodes shall be solid-drawn high conductivity copper rods.

The earth rods shall be of proprietary manufacture 15mm diameter driven into the ground to a minimum depth of 2.4 metres providing the ground conditions are suitable, made up of sections 1.2 metres long with internal screw and socket joints and fitted with a hardened steel tip and driving cap.

A minimum of two earth electrodes shall be provided for each main earthing system with the earth conductor brought back to the main earth bus bar for each electrode.

Connections to the earth electrodes shall be readily accessible for periodic inspection and shall be protected against mechanical damage and corrosion. The actual connection to the rod shall be by means of a purpose made clamp and shall be made below ground level in a concrete inspection pit having a removable cover.

Where an earth electrode system is installed, soil resistivity or other tests shall be carried out to ensure that the required earth loop impedance figures shall be in accordance with the IEE Regulations.

410.1.5 Earthing of Installations Supplied at Medium or Low Voltages

Unless otherwise specified the earthing lead shall be bonded to the sheath and/or armouring of the supply authority's cable.

410.1.5.1 Earth Continuity

Earth continuity conductors shall be of the sizes specified or if no size is particularly specified, they shall be in accordance with IEE Regulations. All such conductors other than tapes shall be insulated with green/yellow PVC.

Earth clamps shall comply with BS 951.

Earth tapes which are fixed to the walls shall be clamped on to stand-off brackets to afford a clearance of 5mm. Connections to the earth tape shall be clamped or revetted and soldered.

The metal sheaths and / or armouring of paper and PVC insulated cables shall be bonded to the metal parts of the equipment to which they are connected.

In cases of circuits protected by fuse-links or MCB's of rating not greater than 10 amperes, electrical continuity may be obtained between the sheaths of MICC cables and the equipment to which they are connected providing:-

- a. The surfaces of equipment are cleaned free from paint or other non-conducting materials and cleaned surfaces are coated with petroleum jelly.
- b. MICC cable glands are screwed into spouted boxes or fixed with locknuts with compression washers.

Earth coupling shall be connected by means of an insulated copper wire coloured green/yellow which shall be connected by means of a 2BA brass screw secured to the equipment.

In surface conduit installations, where a high degree of neatness is required, plain couplings with compression washers may be authorised.

In light switches ,socket outlets and all equipment outlets the copper earth wire from the couplings shall pass through a hole in the box and terminate into a 2BA brass screw lapped or bolted into the box.

Insulated earth connections shall be provided between the terminal in the box or other enclosure and the terminal on the light switch, socket outlet or other equipment.

Surfaces of all equipment to which earth connections are made shall be cleaned free from paint and other non-conducting material.

The supply and fixing of all earthing and bonding material whether or not shown in detail on the drawings which may be required for the proper and effective earthing and bonding or any equipment shall be considered to be included in the material and labour covered by the supply and installation or that equipment unless the allowance for the work is specifically detailed elsewhere.

410.1.5.2 Impedance

Earth loop Impedance of all feeders shall comply with latest edition of IEE Regulation.

410.1.6 Earthing of Lighting Points

Metal parts of light fittings which are required by the IEE Regulations to be earthed shall be connected to the lighting point earthing terminal by means of a green/yellow insulated conductor of cross section not less than that of the line conductor supplying the fittings.

In an installation wired in conduit or in MICC cable, the earthing terminal shall be a 4BA brass screw pillar terminal, tapped into the base of the conduit box at each light point.

In trunking installations the earthing terminal shall be provided by means of the third way in a 3-way connector block used at each light point.

The earthing terminal shall be connected to the trunking earth continuity conductor by means of a green PVC insulated 2.5 mm sq. cable and an insulated line tape such as Metway 205/GL or similar and approved.

410.1.7 Earthing of Socket Outlets

The earthing terminal in the box or other enclosure associated with a socket outlet which is required to be connected by the IEE Regulations to its earthing terminal shall be a 4BA screw brass pillar terminal tapped into the box or other enclosure.

410.1.8 Bonding

The Bonding connections required by the IEE and the MOPW&H Regulations to be made to other services such as gas and water as near as practicable to the point of entry shall be made by means of a solid copper conductor of minimum cross section in accordance with Section 413-2 of the IEE Regulations.

These bonds shall be installed as inconspicuously and neatly as possible. The connections shall be visible after installation.

Frames of motors, generators, metal cases of switchgear and all metal-clad or enclosed apparatus, metal sheath and armouring of cables and conduits shall be electrically continuous and connected to the main earth system.

The electrical continuity of the earthing system shall be such that the electrical impedance between the main switch and any other part of the works shall not exceed 1 ohm.

All earth tapes and conductors that run underground or through walls shall be either PVC lapped or served with corrosion resisting compound.

Where tapes are run underground, their presence shall be indicated by marker tapes laid directly above the cables after the trench has been backfilled, the tapes being approximately 300mm below the surface level.

The tapes shall be manufactured from high grade polythene 150mm x 0.1mm gauge coloured yellow with the words "Electrical Cable Below" printed along its length in English and Arabic.

All metal sinks, baths, wash-hand basins, water coolers, water heaters etc. shall be bonded to earth in accordance with the State Electricity Department and IEE Regulations.

At the entry position of water services, on the incoming side of the main stopcocks, the Contractor shall supply and fit a purpose made earth clamp. Before the earth clamp is fitted the pipe shall be thoroughly cleaned to give a good metal joint. The earth shall conform to BS 951 and shall be labelled.

END OF SECTION

SECTION 1600-510

LIGHTING FITTING

LIGHT FITTINGS

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510.1 Light Fittings

510.1.1 Luminaries and Lamps

510.1.1.1 General

All luminaries with weather proof IP rating shall be manufactured from material and finishes suitable to withstand the conditions prevailing in the area.

The appearance and light distribution characteristics of all luminaries shall comply with the detailed information given in this Specification. The design and construction of the luminaries shall be such that lamp caps and holders are not subject to temperatures in excess of the continuous running temperatures for which they are designed.

All luminaries installed internally shall be suitable for continuous operation in an ambient temperature of 50°C. External luminaries, in areas shielded from direct sunlight, shall be suitable for operation in an ambient temperature of 50°C.

All metalwork shall be made impervious to rust or corrosion by the use of rust inhibitors and painting in the case of steel or by clear cellulose finishes or non-ferrous metals, where their natural colours are required.

Each luminaire is identified on the drawings by means of an explicit symbol, details are given of the type of luminaire corresponding to each symbol in the legend sheet.

Any unit incorporating wording on the diffuser shall have this provided in both Arabic and English. During material submittal stage, contractor shall ensure to submit well organised, well presented formats of light fittings. Only original catalogues will be accepted and submittal shall include complete technical information related to luminaries, lamps, control gear, suspension arrangements, together with samples etc.

510.1.2 LED Luminaries

Luminaries using LED lamps shall be supplied with electronic transformer and shall be warm colour, Suitable for 40 C temperature minimum.

510.1.3 Fluorescent Luminaries

Fluorescent luminaries shall be manufactured in accordance with B.S. 4533.

All fluorescent lamps shall be of the hot cathode type. For general use the lamp characteristics required are as follows and all lamps shall have outputs at least equal to those in the table below.

Characteristics

Wattage	Lumens	Colour temp	Average Life
18W/TLD/T8	1350	4000	12000
36W/TLD/T8	3350	4000	12000
14 W/T5	1350	4000	16000
28 W/T5	2900	4000	16000
11W/CFL	900	4000	8000
13W/CFL	900	4000	8000

18W/CFL	1200	4000	8000
26W/CFL	1800	4000	8000
32W/CFL	2400	4000	11000
42W/CFL	3200	4000	11000
36W/CFL	2900	4000	11000

All fluorescent lighting fixture shall be equipped with electronic control gear.

Electronic control gear (Ballast) and other auxiliary equipment shall be accommodated within each unit in such a manner to permit heat generated to be dissipated to ensure that components operate within their rated temperature limits. Control gear shall be of high frequency electronic type and be power factor corrected to not less than 0.90 lagging.

Each luminaire shall be provided with a 3-way terminal block securely fixed to the base of the channel with the phase neutral and earth cables clearly identified. Each luminaries shall be protected by a separate cartridge fuse of the correct rating. The fuses shall be readily accessible and removable to isolate luminaries from the supply during maintenance.

Ballasts, and lamp holders shall be effectively bonded to the fitting and to the main earth terminal. Lamp holders shall be of the spring loaded type and shall include an earth clip effectively to earth the caps of the fluorescent tubes.

All circuits shall be fitted with radio interference suppressors and all internal circuit wiring shall be multi-strand cords with high temperature insulation retained in channels or by clips.

Where prismatic controllers/diffusers are specified on the Drawings these shall be manufactured from acrylic/polycarbonate material. Under no circumstances will polystyrene diffusers be accepted.

Where metal louvres are specified, these shall be made from non-iridescent aluminium, comprising a combination of photo metrically profiled specular reflectors and cross baffles to form a highly efficient and rigid assembly. The louvre must be designed such that it accurately relocates after normal maintenance in the desired position relative to the tubular light source.

510.1.4 Discharge Luminaries

All lamps shall be suitable for 230 volt operation and be complete with control gear. The Characteristics of mercury, metal halide and high pressure sodium lamps shall be such that they will start and operate with a 10% reduction in rated voltage.

High pressure sodium lamps shall conform to IEC Publication 662. The lamps shall be elliptical type with diffusing coating and shall be fitted with Edison screw caps.

Mercury and metal halide lamps shall be of the elliptical type with internal fluorescent phosphor coating and fitted with Edison screw caps. They shall conform to B.S. 3677 or IEC 188.

Discharge lamp ballasts shall be of the current limiting type manufactured to B.S. 2818 or IEC 82 and provided with a capacitor in every case to ensure the power factor of each luminaire is not less than 0.9 lagging.

All car park and externally mounted discharge luminaries shall be provided with an electronic ignitor for starting purposes.

A fuse shall be incorporated with the luminaire control gear and care shall be taken to ensure the fuse fitted complies with the manufacturer's recommendations. The control gear tray shall be easily removable via plug and socket connection.

Discharge lamps shall exhibit the following characteristics and all lamps shall have outputs at least equal to those below:-

Characteristics

Wattage	Lumens	Colour Temp. (k)
Metal Halide & CDM		
250	16000	4000
400	24000	4000
70	5500	5000
150	12000	5000
High Pressure Sodium (SON)		
50	3100	2000/2200
70	5300	degrees K
150	15000	
250	25000	

All discharge lamps to be of minimum 10,000 hours lamp life

510.1.4.1 Lighting Switches

Local switches for the control of lighting circuits shall be suitable for surface or flush mounting to suit the location.

Surface mounted units shall be IP 56 pattern when installed outside buildings or metal clad plated pattern for indoor use such as substation rooms, plant rooms etc.

Flush switch units shall be provided with plates of matt stainless steel unless otherwise indicated on drawings.

The switches shall be of the quick make slow break type designed for control of a.c. circuits and shall be rated at minimum of 15amps. throughout, and shall be of the broad rocker type, ganged to give multiple switch units as necessary.

Where "weather-proof" (w/p) switches are indicated these shall be surface pattern generally as described above but provided with a sealed membrane cover over the rocker switch to prevent the ingress of moisture.

The switches shall conform to BS 267-1963.

Wherever more than one switch is shown on the drawings, they shall be multi-gang and where they are wired with different phases, phase barriers shall be used with warning labels.

510.1.4.2 Time Switches

Time switches shall be photo-resistor type mounted remote from the contactor at the place approved by The Engineer. These photo-resistors shall be equipped with lux adjustment to operate the switch at the desired light level.

As an alternative to the above, an electro-mechanical time switch can be provided. Time switch shall be suitable for solar time adjustment throughout the year. It shall have 12 hours reserve winding so that the power failure up to 12 hours will not change the operating time of the switch

The Contactor shall be of the rating indicated on the drawings and shall conform to relevant British Standards.

The Contractor shall also provide an override switch to switch on and switch off the lights in the event the time switch fails to operate.

510.1.4.3 INDOOR & OUTDOOR LIGHTING FIXTURES CATALOGUE CUTS

The following catalogue cuts presented hereafter is to describe the intended fixture(s) shapes, and shall be read in conjunction with the fixture(s) description on the drawings

The contractor shall submit all details and technical data of lighting fixtures; the same shall as per the owner and engineer approval.

All LED lighting fixtures shall be equipped with electronic transformer.

All transformers/switch gears/ballasts/emergency kits are to be European made.

The following information for all types of lighting fixtures shall to be submitted for consultant review and approval:

- 1.1 Complete details and technical specifications of transformers, ballasts, gears for metal halide type and emergency kits for emergency lighting fixtures.
- 1.2 Dimension of all lighting fixtures including the required false ceiling modules, cut-out for recessed mounted type
- 1.3 Compliance statements
- 1.4 Colour of all finishing material. The finishes shall be reviewed and approved by the project Architect.
- 1.5 Fixtures samples as required by Engineer

A. Indoor Lighting Fixtures

- 1.6 Lighting fixture, ref. F1 & F1E
Accent lighting fixture with 1W LED lamp, IP-65
Similar to Simes (Italy) # S.5831W.19 or approved equal

TECHNICAL DATA SHEET

S.5831W.19

MICROZIP LED DOWNLIGHT ROUND

-PRODUCT TYPE

False ceiling-recessed down-light fitting.
Recessing depth 95 mm.
IP rating IP 65

-MATERIAL CHARACTERISTICS

"Copper Free" Aluminium die cast housing in EN AB 44100 with high resistance against corrosion.
Stone wash surface treatment prior to painting process.
2 mm thick front trim in Stainless Steel - Grade AISI 316L with 2,5-3% molybdenum content.
A4 grade Stainless Steel screws with 2,5-3% molybdenum content which increases the resistance against corrosion.
Pre treated Silicone Gaskets.
Painting Process:
3 Step Process
1) Surface treatment with BONDERITE. A heavy metal free chemical surface treatment containing ceramic nano particles giving a cohesive, inorganic and highly dense protective coating.
2) PRE POLYMERIZATION a process of introducing an epoxy primer with excellent characteristics to the paint which also offers very high resistance to oxidation due to its Zinc content.
3) POLYMERIZATION a process with the application of polyester powder with high resistance against UV rays and harsh weather conditions. Improved protection for Marine applications.
Mechanical resistance of glass IK 09

-LIGHTING PERFORMANCE

Toughened semiacid-etched glass 8mm thick.
Lamp adjustable $\pm 15^\circ$ position.
LOR -

-INSTALLATION AND MAINTENANCE

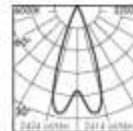
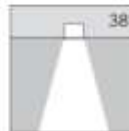
The luminaires are fixed to the falseceiling by a heavy-duty bracket system, adjustable from inside the luminaire.
Front re-lamping without removing the complete fitting from the ceiling.

-WIRING

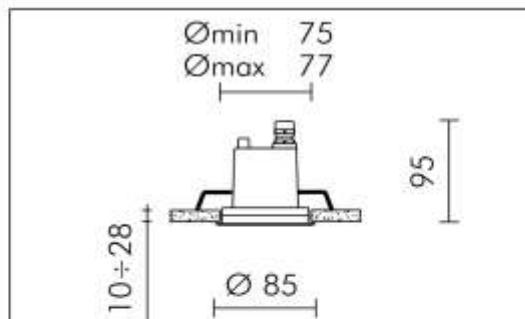
Luminaire hard wired with 1m H07RN-F cable.
Isolation: CLASS I.
Available colours: STAINLESS STEEL (cod.19).
Weight: 0.47 Kg
Glow Wire test: 850°C
Lamp included.

-EMERGENCY VERSIONS

The fittings operates both on AC (50/60Hz) and DC (0Hz) voltage.



Height (m)	38° Beam Diameter (m)	4000K Beam Diameter (m)	3200K Beam Diameter (m)
1	0,69	1,73	1,44
2	1,38	4,0	3,6
3	2,07	1,9	1,6
4	2,75	1,1	0,9
5	3,44	0,7	0,6



1.7 Lighting fixture, ref. F2 & F2E

Ceiling mounted lighting fixture with 2x28w T5 lamp, electronic ballast & matt-opal diffuser, IP-40. Similar to Trilux # 5660904 or approved equal.
 Fixture, ref F2E is equipped with emergency kit 3 hours duration for one lamp only

Product information Valuco D 228 E
TOC: 56 609 04



Surface-mounted luminaires in decorative black/white design with matt-opal diffuser with electronic control gear (E).

Recommended areas

Offices, sales areas, schools, lounges, showrooms, public areas and corridors as well as health care and wellness facilities, rehabilitation centres, spas and homes for the elderly.
 Especially recommended for VDU workstations.

Also suitable for vertical and horizontal wall mounting

Optical system

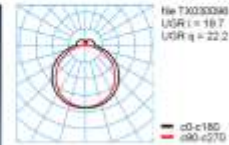
Matt-opal PLEXIGLAS diffuser in stylish finegrained matt surface and which encompasses the luminaire body. Integral reflector made of sheet steel, with highly-reflective white coating.

Luminaire body

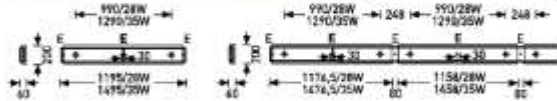
Sheet steel, black. The plastic end caps, protruding from the ends of the luminaire, lend the characteristic appearance-melded bodies.

Control gear option

Versions --28/54-- and --35/49-- in Multi-Lamp technology allow operation of T5 lamps with different wattages.
 With electronic control gear (E)



Degree of protection	IP 40
Safety class	I
Hot wire test	650 °C
Shock resistance	1 J
Citree	BZ 6
Socket	G6
LOR	0,72



available accessories

TOC:	article
46 017 00	ZAA/01
46 917 00	ZAE/01
56 621 00	Valuco ZS/1000
56 623 00	Valuco ZST/1000
56 622 00	Valuco ZS/2000
56 624 00	Valuco ZST/2000
56 625 00	Valuco D ZZT/3075/1000
56 629 00	Valuco D ZZT/5075/1000
56 627 00	Valuco D ZZT/315/1000
56 631 00	Valuco D ZZT/515/1000
56 626 00	Valuco D ZZT/3075/2000
56 630 00	Valuco D ZZT/5075/2000
56 628 00	Valuco D ZZT/315/2000
56 632 00	Valuco D ZZT/515/2000
56 616 00	Valuco ZDV/315/28
56 619 00	Valuco ZDV/515/28
56 752 00	Valuco ZLK 80

All technical data including details of weight and dimensions have been compiled with all due care. Errors excepted. Product illustrations serve as examples and may differ from the original. We reserve the right to make alterations in the interest of improving our products.
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1.8 Lighting fixture, ref. F3

Accent lighting fixture with 35W metal halide lamp, IP-65
Similar to Simes (Italy) # S.6694+S.1004 or approved equal

TECHNICAL DATA SHEET

S.6694 LOFT SPOT

-PRODUCT TYPE

Projector
IP rating IP 65

-MATERIAL CHARACTERISTICS

Aluminium die cast housing in EN AB-47100 with high resistance against corrosion.

Stone wash surface treatment prior to painting process.

A4 grade Stainless Steel screws with 2.5-3% molybdenum content which increases the resistance against corrosion.

Silicone gaskets.

Painting Process :

3 Step Process

1) Surface treatment with BONDERITE. A heavy metal free chemical surface treatment containing ceramic nano particles giving a cohesive, inorganic and highly dense protective coating .

2) PRE POLYMERIZATION a process of introducing an epoxy primer with excellent characteristics to the paint which also offers very high resistance to oxidation due to its Zinc content.

3) POLYMERIZATION a process with the application of polyester powder with high resistance against UV rays and harsh weather conditions. Improved protection for Marine applications.

Mechanical resistance of glass IK 06

-LIGHTING PERFORMANCE

Reflector in 99.98% pure aluminium .

Clear toughened glass.

LOR 73%

-INSTALLATION AND MAINTENANCE

The tempered front glass diffuser is fixed externally to the fitting through silicon resin, perfectly flush with the front ring.

Water and dirt deposits that can disturb the lighting performance of the projector can easily flow away.

The pre-wired connecting wall plaque and its fast connector make the installation and maintenance process quick, easy and safe.

-WIRING

Single cable entry.

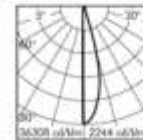
Isolation: CLASS I .

Available colours: WHITE (cod.01), ALUMINIUM GREY (cod.14).

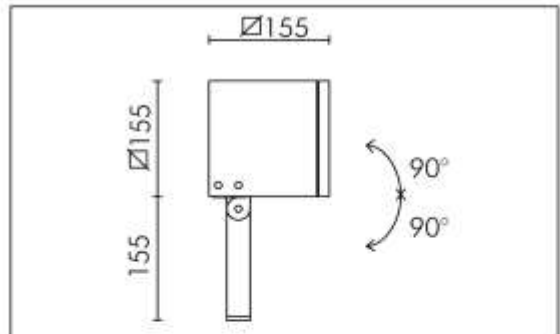
Weight: 3.11 Kg

Glow Wire test: --

Lamp not included.



h(m)	Ø(m)	E(lx)	Ø(m)	E(lx)
2	0.16	27231	1.03	1758
4	0.32	6808	2.07	439
6	0.48	3026	3.10	195
8	0.64	1702	4.14	110
10	0.80	1089	5.17	70



LAST UPDATE 21/11/2012

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1/2

Distributor for Jordan

WATCO

ACCESSORIES FOR S.6694



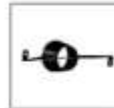
S.6600
ANTI GLARE SHIELD
For 5° reflector.



S.6605
EXTENSIVE LENS



S.1004
STAKE
In POLYPROPYLENE. Colour: black (code .09). The 100 mm upper part must stay above ground level, according to the norm.



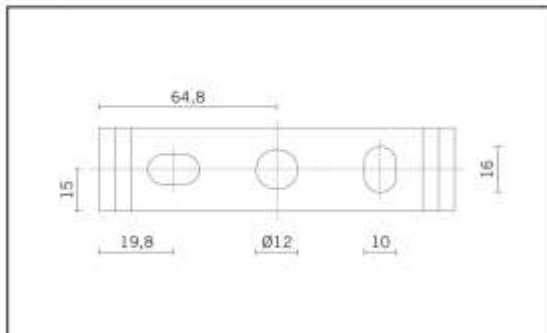
S.6601
ANTI GLARE SHIELD
For 30° reflector.



S.6639
ELLIPSOIDAL BEAM LENS

Further information

FIXING BASE



LAST UPDATE 21/11/2012

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1.9 Lighting fixture, ref. F4

Accent lighting fixture with 1W LED lamp, IP-67
Similar to Simes (Italy) # S.5818W.19 or approved equal

TECHNICAL DATA SHEET

S.5818W.19

MICROZIP ACCENT LED ROUND

-PRODUCT TYPE

Inground walk over fitting
 Recessing depth 110 mm
 IP rating IP 67

-MATERIAL CHARACTERISTICS

Copper Free Aluminium die cast housing in EN AB 44100 with high resistance against corrosion.

Stone wash surface treatment prior to painting process.

2 mm thick front trim in Stainless Steel - Grade AISI 316L with 2.5-3% molybdenum content.

A4 grade Stainless Steel screws with 2.5-3% molybdenum content which increases the resistance against corrosion.

Pre treated Silicone Gaskets.

Painting Process :

3 Step Process

1) Surface treatment with BONDERITE. A heavy metal free chemical surface treatment containing ceramic nano particles giving a cohesive, inorganic and highly dense protective coating.

2) PRE POLYMERIZATION a process of introducing an epoxy primer with excellent characteristics to the paint which also offers very high resistance to oxidation due to its Zinc content.

3) POLYMERIZATION a process with the application of polyester powder with high resistance against UV rays and harsh weather conditions. Improved protection for Marine applications.

Mechanical resistance of glass IK 08

Maximum load capacity 1000 Kg

-LIGHTING PERFORMANCE

Toughened semiacid-etched glass 8mm thick.

Lamp adjustable $\pm 15^\circ$ position.

LOR -

-LOW SURFACE TEMPERATURE

Surface temperature of glass 37°C (Ta 25°C)

-RECESSING BOX

Polypropylene recessing box with cable entry on all 4 sides also allows:

- 1) Easy wiring;
- 2) Cable management for IP67 fast connector;
- 3) Easy access to the fitting for maintenance purposes.

-WIRING

Supply 1.5m cable section type HO7RN-F secured and sealed with B component epoxy resin, wired internally protected by silicon sheaths.

Fast connector M20 (Ø 6+12 mm) IP67 supplied as standard for single cable connection.

Connector housed inside the recessing box.

Front re-lamping without removing the complete fitting.

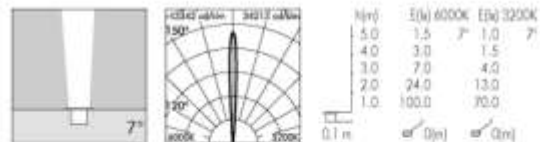
Isolation: CLASS I.

Available colours: STAINLESS STEEL (cod.19).

Weight: 0.63 Kg

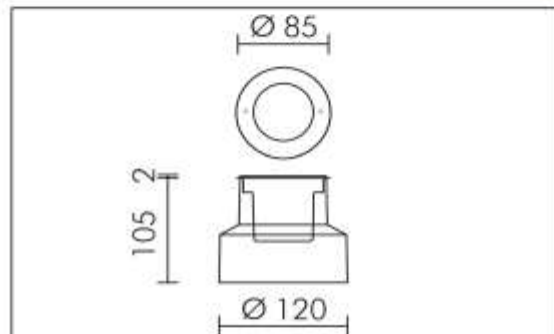
Glow Wire test: 960°C

L.E.D circuit included.



1 ACCENT LED 3200K 1W 230V 100 lm
 Electronic transformer 220+240V 50+60Hz

IP 67



FAST CONNECTOR INCLUDED

LAST UPDATE 21/11/2012

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1/1

1.1 Lighting fixture, ref. F5
Buried drive over with 6W LED lamp, IP-67
Similar to Simes (Italy) # S.4953W.19 or approved equal

TECHNICAL DATA SHEET

S.4953W.19 MINIRING

-PRODUCT TYPE

Inground drive over fitting,
Recessing depth 175 mm
IP rating IP 67

-MATERIAL CHARACTERISTICS

Copper Free Aluminium die cast housing in EN AB 44100 with high resistance against corrosion.

Stone wash surface treatment prior to painting process.

3 mm thick front trim in Stainless Steel - Grade AISI 316L with 2.5 -3% molybdenum content, with high resistance against corrosion.

A4 grade Stainless Steel screws with 2.5-3% molybdenum content which increases the resistance against corrosion.

Pre treated Silicone Gaskets.

Painting Process :

3 Step Process

1) Surface treatment with BONDERITE. A heavy metal free chemical surface treatment containing ceramic nano particles giving a cohesive, inorganic and highly dense protective coating.

2) PRE POLYMERIZATION a process of introducing an epoxy primer with excellent characteristics to the paint which also offers very high resistance to oxidation due to its Zinc content.

3) POLYMERIZATION a process with the application of polyester powder with high resistance against UV rays and harsh weather conditions. Improved protection for Marine applications.

Mechanical resistance of glass IK 10

Maximum load capacity 5000 Kg

-LIGHTING PERFORMANCE

semiacid-etched Toughened glass 15mm thick.

Lamp adjustable $\pm 15^\circ$ position.

LOR 50%

Compact electronic ballast to guarantee better lamp stability, lifetime and reduced energy consumption.

-LOW SURFACE TEMPERATURE

Surface temperature of glass 33°C (Ta 25°C)

Electronic Ballast generating less heat.

Specific layout of internal components allow for better heat dissipation therefore limiting the temperature generated inside the fitting.

-RECESSING BOX

Recessing box in Polypropylene with cable entry on all 4 sides also allows:

- 1) Easy wiring;
- 2) Cable management for fast connector;
- 3) Easy access to the fitting for maintenance purposes.

-WIRING

Supply 0.5m cable section type HQ7RN-F secured by cable gland PG 13.5 (\varnothing 6+12 mm) and sealed with B component epoxy resin, wired internally protected by silicon sheaths.

Fast connector M20 (\varnothing 5+14 mm) supplied as standard for single cable connection.

Connector housed inside the recessing box.

Front re-lamping without removing the complete fitting.

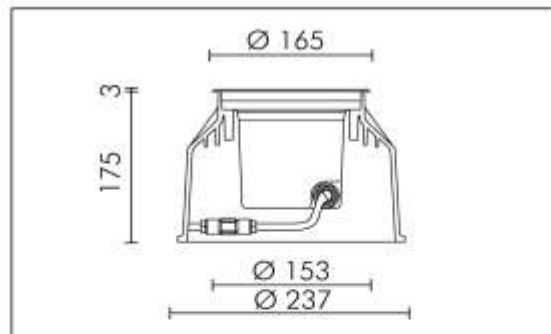
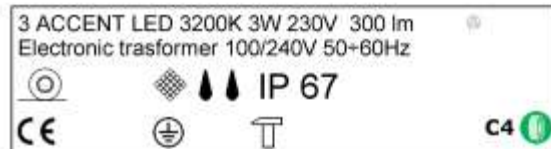
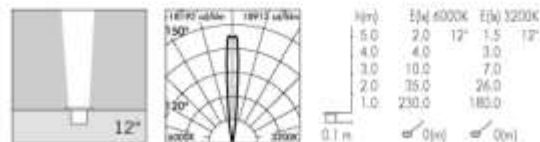
Isolation: CLASS I.

Available colours: STAINLESS STEEL (cod.19).

Weight: 2.72 Kg

Glow Wire test: 750°C

L.E.D circuit included.



FAST CONNECTOR INCLUDED

LAST UPDATE 21/11/2012

Distributor for Jordan

World Axis Trading Co.
P.O. Box 1482
Amman 11821 Jordan
Tel: +962 65510655 - Fax: +962 65510657
http://www.watco.jo.com - e-mail: watco@go.com.jo

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<http://www.simes.it>

1/1

1.2 Lighting fixture, ref. F6

Spike light with 6W LED lamp

Similar to Simes (Italy) # S.3595 or approved equal

TECHNICAL DATA SHEET

S.3595 MICROTECHNO SPOT LED

-PRODUCT TYPE

Projector
IP rating IP 65

-MATERIAL CHARACTERISTICS

Aluminium die cast housing in EN AB 47100 with high resistance against corrosion.

Stone wash surface treatment prior to painting process.

A4 grade Stainless Steel screws with 2.5-3% molybdenum content which increases the resistance against corrosion.

Pre treated Silicone Gaskets.

Painting Process :

3 Step Process

1) Surface treatment with BONDERITE. A heavy metal free chemical surface treatment containing ceramic nano particles giving a cohesive, inorganic and highly dense protective coating .

2) PRE POLYMERIZATION a process of introducing an epoxy primer with excellent characteristics to the paint which also offers very high resistance to oxidation due to its Zinc content.

3) POLYMERIZATION a process with the application of polyester powder with high resistance against UV rays and harsh weather conditions. Improved protection for Marine applications.

4 mm thick tempered glass diffuser.

Mechanical resistance of glass IK 06

Maximum load capacity –

-LIGHTING PERFORMANCE

The lathed anodized reflector is composed of 99.98% pure aluminium with a bright polish finish.

LOR –

-INSTALLATION AND MAINTENANCE

The projector is supplied with graduated ferrules on both sides of the fitting.

Power supply connection takes place by means of a disconnecting switch. This facilitates installation on walls because you can attach the base and do the wiring, positioning the complete unit at the end of the installation.

-WIRING

Single cable entry.

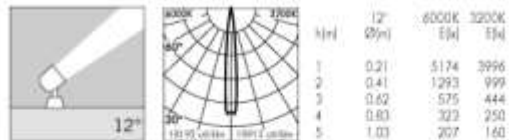
Isolation: CLASS I

Available colours: ALUMINIUM GREY (cod.14), ANTHRACITE GREY (cod.24).

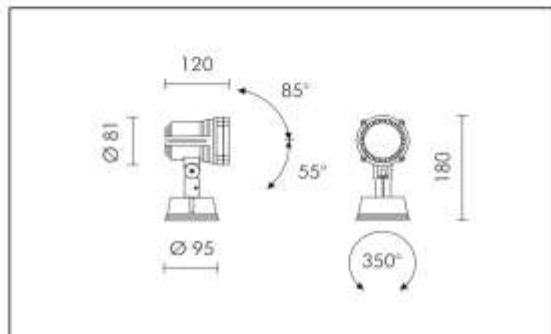
Weight: 0.89 Kg

Glow Wire test: 950°C

L.E.D circuit included.



3 ACCENT LED 6000K 3W 230V 390 lm
Electronic transformer 100/240V 50+60Hz



LAST UPDATE 21/11/2012

Distributor for Jordan

World Axis Trading Co.

P.O. Box 1482

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1/2

1.1 Lighting fixture, ref. F7

Surface mounted LED fixture with aluminium profile, IP-67

Similar to OPTOLED (Germany) # Opto Lume or approved equal.

optoLUME®



LED linear luminaire for surface or recessed installation
Minimum dimensions and high efficacy

Characteristics

Versatile highly efficacious luminaire with slender extrusion profile housing

optoLUME® ist an exceptionally small luminaire based on the optoFLEXLIGHT® LED-tapes and the optoLUX® profiles.

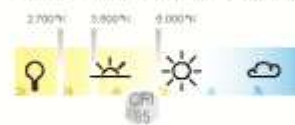
Three performance levels and three colour temperatures combine with three cover types and three transmission levels.

Particularly suited for accentuating contours or powerfully lighted lightlines with even luminance without LED hotspots.*

*with cover HO and RO

Properties

- Three performance levels for accentuation or general lighting
- Drei precise colour temperatures



- High efficacy up to 82,64 lm/W
- High colour rendition index CRi>85
- Life span of LEDs up to 50 000h
- 24V DC SELV with external converter

- Optional IP67 with PU cast



optoFLEXLIGHT®



Three performance levels

- 600 lm/m** LUNA
Homogeneous ambient light
- 1400 lm/m** STELLA
Highly efficient lighting
- 3200 lm/m** LUZ
Powerful general lighting without limitations*
*optional, additional heat sink obligatory

Three times three covers*

- TALL**
PMMA / 20x20mm
- ROUND**
PMMA / 20x20mm
- FLAT**
PC / 13x20mm (optional)
*further covers Opal, Diffuse, Clear optional

Lengths*

- 560 mm** LUNA 6,6W / max 330lm
- 860 mm** LUNA 10,2W / max 510lm
- 1000 mm** STELLA 11,5W / max 1365lm
- 1970 mm** LUNA 23,4W / max 1170lm
- 1970 mm** STELLA 37,5W / max 2730lm
- *other lengths <1.970mm optional

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optoLUME®

LED linear luminaire with minimum dimensions and high efficacy

Applications

General lighting, direct and indirect, e.g. cove lighting, contours, hand rails

Interior and exterior accentuation and contours

Countertop lighting
Display and shelf lighting

Properties

- W 19,5mm
 - Standard lengths: 560 / 860 / 1970mm and 1000 / 1970mm
 - Standard heights: 20 / 20 / 13mm
- Converter available with 10, 25, 60, 100 W, several luminaires operate with one converter

Continuous mounting profile clips onto luminaire

- 24V DC SELV
23Vmin > 25Vmax
- Operating temperature
-25°Cmin > +50°Cmax.*
- Storage temperature
-40°C min. > +85°C max.

*additional heat sink required for version LUZ, see mounting and safety instructions



Type specification and article number for IP20, PU cast and set-up costs at extra charge for IP67

LUNA L 560mm

Type 1	Order no. 1	Type 2	Order no. 2	Type 3	Order no. 3	Colour	Colour temp. °K*	Lum. flux lm*	Power W*
Round/Opal	210500RO	Tall/Opal	210500HO	Flat/Tr.	210500FT	White	5 000	330	6,6
Round/Opal	210400RO	Tall/Opal	210400HO	Flat/Tr.	210400FT	Neutral w.	3 500	330	6,6
Round/Opal	210270RO	Tall/Opal	210270HO	Flat/Tr.	210270FT	Warm w.	2 900	319	6,6

LUNA L 860mm

Type 1	Order no. 1	Type 2	Order no. 2	Type 3	Order no. 3	Colour	Colour temp. °K*	Lum. flux lm*	Power W*
Round/Opal	310500RO	Tall/Opal	310500HO	Flat/Tr.	310500FT	White	5 000	510	10,2
Round/Opal	310400RO	Tall/Opal	310400HO	Flat/Tr.	310400FT	Neutral w.	3 500	510	10,2
Round/Opal	310270RO	Tall/Opal	310270HO	Flat/Tr.	310270FT	Warm w.	2 900	493	10,2

LUNA L 1970mm

Type 1	Order no. 1	Type 2	Order no. 2	Type 3	Order no. 3	Colour	Colour temp. °K*	Lum. flux lm*	Power W*
Round/Opal	410500RO	Tall/Opal	410500HO	Flat/Tr.	410500FT	White	5 000	1 170	23,4
Round/Opal	410400RO	Tall/Opal	410400HO	Flat/Tr.	410400FT	Neutral w.	3 500	1 170	23,4
Round/Opal	410270RO	Tall/Opal	410270HO	Flat/Tr.	410270FT	Warm w.	2 900	1 131	23,4



Version **LUZ** L 1000mm und L1970mm optional, additional heat sink obligatory (see mounting and safety instructions)

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END OF SECTION



SECTION 1600-720

CONVENTIONAL FIRE DETECTION AND ALARM SYSTEM



CONVENTIONAL FIRE DETECTION AND ALARM SYSTEMS

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720.1 CONVENTIONAL FIRE DETECTION AND ALARM SYSTEMS

720.1.1 GENERAL

720.1.1.1 Scope

- 1 This part specifies the requirements for the material, installation, testing and commissioning of fire alarm and detection systems for use within buildings. It covers all the system components for efficient operation.

720.1.1.1.1 References

- 1 The following standards and references are referred to in this Part:
BS 5445 Components of automatic fire detection systems
BS 5839 Fire detection and alarm systems for building
BS 5306 Fire extinguishing installations and equipment on premises
BS 6360 Conductors in insulated cables and cords

720.1.1.1.2 Contractor's Responsibility

- 1 The Contractor shall arrange for an approved sub-contractor, to supply, install, wire and commission the complete manual/automatic fire alarm system comprising manual fire alarm call points, alarm bells and sounders, smoke and heat detectors optical smoke detectors, combined smoke and heat detectors, duct mounted smoke detectors, flame detectors, alarm heights (xenon beacon), remote indicating lights' and control panels as indicated on the drawings. The system shall be designed, installed and maintained in accordance with the recommendations of BS 5839.

720.1.1.1.3 System Description

- 1 The Contractor shall provide and install the system in accordance with the Project Documentation, applicable codes and manufacturer's recommendations.
- 2 Fire alarm panels, repeater panels, detection components, alarm components, cables, other materials and their installation shall be approved by THE Local Civil Defence Department,
- 3 The fire alarm system sub-contractor shall be registered with, and on the approved contractors list of the Civil Defence Department.
- 4 The fire alarm and automatic detection systems shall meet the requirements and comply with the relevant British Standards and shall meet the requirements of National Fire Protection Association.
- 5 The system shall be suitable for 240 V, 1 phase, 50 Hz power supply and be complete with standby sealed lead acid gas-recombination type long life batteries and charger to provide a 24 V DC for detection and alarm system.

- 6 Where the installation extends beyond more than one building the system in each building shall be self-contained with visual and audible alarms. A common fire alarm and common fault signal from each system shall be displayed on the control room repeater panel.

720.1.1.1.4 Quality Assurance

- 1 Items and equipment specified in this part shall be provided by experienced and approved manufacturers and contractors as designated in the Project Documentation or to the written approval of the Engineer. All equipment shall be UL listed and shall be supplied from the same manufacturer who has a minimum of 10 years experience in the active manufacturing of fire alarm systems.

720.1.1.2 CABLING

720.1.1.2.1 General

- 1 The wiring size shall be not less than 1.5 mm² for call/detector circuits and 2.5 mm² for bell and battery circuits. The system shall be of the two wire type.
- 2 Cabling in fire alarm detection systems shall comply with the relevant provisions of BS 6883 and BS 5839.
- 3 In enclosed work areas and accommodation areas, zero halogen type cables shall be used.
- 4 Cables shall be able to withstand the IEC 331 gas flame test, enhanced to 3 hours at 950 oC.
- 5 Conductors shall be circular tinned wires complying with the relevant provisions of BS 6360, Class 2.
- 6 The Contractor shall provide and install the system in accordance with Project Documentation, applicable standards and manufacturer's recommendations. All wiring shall be in a conduit system which is separate from other building wiring. Junction boxes shall be sprayed red and levelled "Fire Alarm".

720.1.1.2.2 Cables

- 1 Fire alarm cables shall be rated for 600/1000 V grade unless otherwise stated in the Project Documentation.

720.1.1.2.3 Insulation

- 1 Fire alarm system cables shall have the following type of insulation as specified in the Project Documentation:
 - (a) pressure packed magnesium oxide insulation
 - (b) a composite insulation of mica impregnated glass tape beneath an extruded layer of ethylene propylene rubber (EPR)
 - (c) silicone rubber insulation.

720.1.1.3 CONTROL PANEL

720.1.1.3.1 General

- 1 The main fire alarm control panel shall be located in the main control room and shall be wall mounted. The fire alarm system shall protect all risk areas within the premises by giving warning of a fire condition when detected by an automatic detector or by the manual operation of a break glass call point. The risk area shall be divided into zones and each zone shall have its own fire indicator on the control unit. The control and indicating equipment, power supply unit and repeater panels shall comply with the electro-magnetic compatibility (EMC) test requirements described in BS 5839 and the Electronic Engineers Commission (EEC) requirements for the EMC directive 89/336/EU and the subsequent amendment 92/31/EU.
- 2 A diagram shall be provided adjacent to the control panel showing the general layout of the building and the fire zones. The diagram shall be engraved with black paint filling on a white ebonite sheet of thickness not less than 2 mm. The letter height shall be 5 mm. The diagram shall be coloured to show the extent of the area covered by each fire zone. A different colour shall be used for each zone.
- 3 Upon receipt of an alarm, the control units shall perform the following actions:
 - (a) illuminate fire zone detector
 - (b) activate alarm warning devices within the building
 - (c) operate internal fire sounder
 - (d) operate ancillary devices as appropriate
- 4 Alarm warning devices shall be de-activated by operation of the 'Silence Alarms' switch. The internal sounder will continue to operate and the fire indicators remain lit until the key switch controlled push switch is operated. This should only be achieved if the alarm initiating device is no longer in alarm.
- 5 Reset of the controller, after the fire incident has been investigated, will be achieved by operation of the 'Reset' switch.
- 6 The fire alarm panel shall comply with BS 5839 Part 4 and requirements herein and be suitable for installation of fire detection and alarm systems to BS 5839 Part 1.

720.1.1.3.2 Fabrication

- 1 The panel shall be of the multi-zone, modular type and capable of extension. The number of zones shall be related to the requirements of the individual buildings and shall be agreed with the Engineer. As a minimum, the fire alarm panel is to be wall mounted and suitable for 6 zones with all modules installed.
- 2 A lockable smoked glass door shall protect the face of the panel from access by unauthorised personnel.
- 3 The enclosures of panels shall be fabricated from sheet steel, minimum thickness 1.5 mm and shall be provided with a hinged lockable door. Protection to at least IP54 shall be provided.
- 4 Control panels shall as a minimum requirement be equipped with the following:
 - (a) mains supply on indicator
 - (b) DC supply faulty indicator

- (c) alarm indicator for each zone
 - (d) alarm accept push-button to acknowledge fire alarm signals, silence external audible alarms and energise an internal bleeper unit or sounder
 - (e) reset push-button to restore monitoring systems to the inactive condition
 - (f) integral sealed battery and trickle battery charger where appropriate
 - (g) alarm transmission facilities via the telephone alarm system (this facility shall be provided for future use if not utilised under this Contract)
 - (h) termination for incoming and outgoing wiring systems
 - (i) voltage free normally closed circuits which shall open in the event of an alarm to shutdown ventilation and air conditioning equipment in the immediate vicinity of the alarm
 - (j) suitable fault indication (both visual and audible)
 - (k) interfacing facility to connect to Civil Defence Department system
 - (l) interfacing facility to control elevator system
 - (m) interfacing facility to control air handling units (AHU) of the HVAC systems
 - (n) interfacing facility to control fire doors/dampers.
- 5 Alarm indicators shall be of the light emitting diode type. Indicators shall be provided in pairs for each function.
- 6 Control panels shall continuously monitor all alarm circuits, including wiring and control devices. When a fault monitoring circuit has been energised it shall not rest until the fault condition is cleared.
- 7 The control panel shall include the following:
- (i) power supply normal light (green LED)
 - (ii) power supply fault light (amber LED)
 - (iii) battery charger fault light (amber LED)
 - (iv) general evacuate push button
 - (v) silence alarm push button
 - (vi) reset push button
 - (vii) common fire light (twin red LED)
- 8 Repeat facilities shall be available for common fire and fault conditions. In addition, two normally open/normally closed (NO/NC) volt free auxiliary contacts each rated at 2.5 amps (inductive) for 24 V DC and 240 V AC shall be available

- 9 Cable entries are to be made from knock-outs located on top and bottom of the fire alarm panel.
- 10 The removal of any detector(s) shall not effect the performance of other detectors in the system.
- 11 The sensitivity of any of the sensors shall be adjustable from the control panel.

720.1.1.4 BATTERIES AND CHARGING EQUIPMENT

720.1.1.4.1 General

- 1 The system shall be of the 24 V DC, monitored, open circuit type utilising transformed and rectified mains voltage supply under all normal circumstances but with stand-by provision in the form of rechargeable sealed lead-acid batteries.

720.1.1.4.2 Batteries

- 1 Batteries shall have a capacity capable of maintaining the system in normal working condition for at least 24 hours and in the alarm state for at least 30 minutes without recharging unless otherwise stated in the Project Documentation.

720.1.1.4.3 Battery Chargers

- 1 Battery chargers are to be of sufficient capacity to power the system whilst recharging a fully discharged battery. The battery shall be fully charged within 8 hours.

720.1.1.5 DETECTORS

720.1.1.5.1 General

- 1 Detectors shall conform to the relevant provisions of BS 5445 and be fully compatible with the system offered and shall comprise a fixed base which can be used with other types of detector head.
- 2 The base shall have fixed non-corroding terminals and contain no electronic components.
- 3 The head shall comprise the sensing elements which shall be housed in a corrosion proof enclosure which can be fixed to the base by a bayonet or plug-in twist-lock mechanism.
- 4 The sensing elements shall be exposed to the atmosphere through a protective cover which will allow free movement of air but provide a high degree a resistance to dust and insects. A small drain hole shall be included to allow any condensation to drain.
- 5 Integral LED's shall be provided which will confirm operation and also permit detector testing.
- 6 The removal of a detector from its base shall cause a fault signal to be indicated.
- 7 It shall be clearly stated on the head of the detector the type of element it contains or the principle on which the detector operates.
- 8 All detectors shall operate at a nominal voltage of 24 V DC and shall exhibit long-term stability and reliability under the prevailing conditions at the installation location.

720.1.1.5.2 Optical Smoke Detectors

- 1 The sensors shall utilise the light scattering principle. They shall employ a photoelectric cell and light source so arranged that only light scattered by smoke particles falls on the photoelectric cell.
- 2 The Optical smoke detector shall respond to the visible smoke produced by smouldering or burning materials.
- 3 The detector shall be fully operational after initiation of an alarm without any maintenance.

720.1.1.5.3 Heat Detectors

- 1 The detector shall be a combined unit including both fixed temperature element and rate of rise temperature element.
- 2 Each heat detector shall incorporate a dual thermal element, which responds to either an excessively high temperature or a rate of rise of temperature which is unacceptable.
- 3 The heat detector shall operate on the principle that one element is exposed to the atmosphere whilst the other is contained in such a way that it is not so readily affected by increasing temperature. At a certain rate of rise of temperature or at a pre-set fixed temperature, the imbalance between the two elements shall cause the detector to trigger.
- 4 The fixed element of the heat detector shall be the type that can be reset for renewed detection. The detector shall be fully operational after initiation of an alarm without any maintenance

720.1.1.5.4 Remote Indicating Lights

- 1 All fire detectors shall be provided with remote indicator facility. The remote indicator output shall diode gated for protection against electrical interference generated along the remote indicator wiring and to enable one remote indicator to be connected to a number of detectors. The remote indicator shall be polarity independent and operate at constant brightness over the range of 8-28 V.

720.1.1.6 ALARMS

720.1.1.6.1 Manual Fire Alarm Call Points

- 1 Manual fire alarm call points shall consist of a die cast plastic enclosure with a die cast plastic cover locked in position with screws. The enclosure shall house a micro switch. The micro switch plunger shall bear onto an inset break glass panel fixed into the cover. The call point shall be arranged for surface or flush mounting as appropriate. The cover and the enclosure shall be self coloured red. The words 'BREAK GLASS FOR ALARM' shall be printed on the frangible glass. A testing facility using a special key shall be provided to enable the call point to be tested without breaking the glass and the frangible glass shall be covered with plastic film to prevent injury when the glass is broken. The mounting height shall be 1400 mm above finished floor level.
- 2 The switching unit contacts shall be gold or silver plated or on alloyed metal which will not corrode when left unattended in a highly polluted environment. Contact blades and other metal parts of the switching unit shall also be constructed from plated or alloyed metal which will not corrode when left unattended. Contacts shall be normally open or normally closed to suit the alarm monitoring system. The voltage and current

rating of the contacts shall be marked within the enclosure. The items shall have approval and listing by the LPCB (Loss Prevention Council Board).

- 3 The call point shall be suitable for direct connection into the wiring system, and shall comply with the relevant provisions of BS 5839: Part 2.
- 4 The call point shall be resistant to the ingress of dust and water to IP55.

720.1.1.6.2 Alarm Bell

- 1 Red under dome indoor fire alarm bells shall be installed in locations complying with the relevant provisions of BS 5839 and in locations as indicated in the Project Documentation. Each bell shall be suitable for 24 V DC operation and shall be polarised. The output shall not be less than 90 dBA at 1 m distance. 150 mm diameter under dome bells shall be used indoors and 225 mm diameter under dome bells shall be used outdoors. Outdoor under dome bell shall be to IP44.
- 2 Alarm bells shall be of the gong type. They shall be continuously rated and mounted 2200 mm above finished floor level.
- 3 Bells shall be painted red and marked with the words "FIRE ALARM".
- 4 Each bell or sounder circuit shall have a separate fuse at the fire alarm control unit.

720.1.1.6.3 Electronic Sounders

- 1 Electronic Sounders shall comply with the relevant provisions of BS 5389 and BS 5306 and shall be suitable for 24 V DC use. These sounders shall be coloured red and be polarised, suppressed and suitable for line monitoring. Electronic sounders are to have a low current consumption of approximately 30 mA but have a minimum output of 100 dBA at 1 m.
- 2 The electronic sounder shall be capable of providing at least two distinct and different sounds and be suitable for "on site" adjustments.

720.1.1.6.4 Alarm Lights

- 1 Visual flashing alarm lights shall be located above doors and openings as indicated in the Project Documentation. They shall be of the xenon flashing type and suitable for 24 V DC. The wording "Fire" shall be prominently displayed when this alarm is activated.

END OF SECTION