

SPECIFICATIONS  
CIVIL WORKS



NAQVI & SIDDIQUIE ASSOCIATES (Pakistan)

## SPECIFICATIONS FOR CIVIL WORKS

### GENERAL

The various parts of these Specifications have been grouped as follows:-

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No. 100

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### 2.03 Coarse Aggregate

Coarse aggregates shall be crushed or un-crushed gravel or crushed stone comprising of angular or rounded in shape and shall have granular or crystalline or smooth (but not glassy) non powdery surface free from friable, flaky and laminated pieces, mica and shall and all such matters as may be injurious to concrete. All coarse aggregate shall conform to BS No. 882 and shall be graded as follows:

B.S. Sieve	Passing by weight
1" (25.4 mm)	100
3/4" (19.05 mm)	90-100
3/8" (9.53 mm)	20- 55
3/16" (4.765mm)	0- 10

The aggregates shall be stored on properly constructed paving and bins as directed by the Engineer.

There shall be a physical partition between the stock piles of coarse and fine aggregates. If required aggregates shall be washed and screened to the satisfaction of the Engineer. Sieve analysis of all the aggregates to be used in the works shall be carried out as and when required by the Engineer. All aggregate shall be subject to the approval of the Engineer.

Any aggregates not found to be of the specified/approved standard shall be rejected by the Engineer and all such rejected material shall have to be removed from site without delay.

Floors, sub-base or base constructed with rejected aggregates shall be dismantled and rebuild at the expense of the Contractor.

### 2.04 Stone Ballast

Stone Ballast to be used as soling shall comprise of strong, hard, durable stone of the approved size free from impurities. Quarry sap, dust, dirt and solubility characteristics. The stone shall be obtained from approved quarries and shall be sound, free from laminations and weak cleavages.



#### 2.05 Water

Water used for mixing concrete, curing or any other operation of the works specified herein shall be fresh, clean and free from organic or inorganic matters in solution or suspension. Only water of the approved quality shall be used for all construction purpose.

#### 2.06 Terrazzo Tiles

Terrazzo Tiles shall be first grade, mechanically compressed type conforming to BS-531. Tiles shall be 12"x12"x1" with a topping of 3/4" thickness composed of 1:2 cement white/grey marble chips in size 1/4" to 3/4" the base being 1:2 cement mortar. The colour, quality of size of chips shall be as per Engineer's direction.

#### 2.07 Cleaning Compound

The compound used for cleaning of terrazzo shall be an approved neutral chemical cleaner free from acid and strong alkalies or other material that will effect the colour or otherwise damage the terrazzo and shall not effect the conductivity of terrazzo floors.

#### 2.08 Marble Chips

Marble chips shall have an abrasive hardness of not less than 16 as determined by the test of wear resistance in National Bureau of Standards Report BMS 98. Size shall vary from 3/8" to 3/4".

### 3. CEMENT CONCRETE FLOORING

3.01 The materials for C.C. flooring shall be the same as already specified under the item of RCC work.

#### (a) Composition of Concrete

Concrete shall be composed of Portland Cement, sand coarse aggregates and water, all well mixed and brought to the proper consistency. The Contractor shall mix the ingredients as shown on the drawings.

The proportions of the various ingredients shall be determined from time to time during the progress of the work and tests shall be made to samples of the aggregates and the resulting concrete as and when required. The mix proportions and appropriate water- cement ratio will be determined on the



basis of the production of concrete having required strength.

(b) **Mixing Concrete**

The concrete ingredients shall be mixed in a batch mixer for not less than 1-1/2 minutes after all ingredients, except the full amount of water, are in the mixer. The Engineer reserves the right to increase the mixing time when the charging and mixing operations fail to produce a concrete batch throughout which the ingredients are uniformly distributed and the consistency is uniform. The concrete shall be uniform in composition and consistency from batch to batch except when changes in composition or consistency are required. Water shall be added prior to, during and following the mixer charger operations. Excessive over mixing requiring the addition of water to preserve the required concrete consistency will not be permitted. The concrete ingredients shall be mixed by volumetric measurement in purpose made boxes approved by the Engineer/Consultants.

4. **APPROVED MATERIAL AND WORKMANSHIP**

The Contractor shall submit for approval of the Engineer, materials as specified herein or any other materials used in floors, before the delivery of the materials is made to the site of work. The work shall strictly be performed under instruction or the manufacturer's instructions and as approved by the Engineer/Consultants.

5. **INSTALLATION OF TILE FLOORING**

- 5.01 The base shall be prepared by laying cement concrete of specified grade and of thickness shown on the drawings, or specified in the Bill of Quantities. The C.C. floor will be laid over well compacted stone metal, blinded with sand to fill all voids.
- 5.02 The terrazzo tiles will be laid to the required levels and grades over a setting bed of cement or lime concrete, comprising of one part of cement or lime and four part of sand by volume. The thickness of cement or lime concrete shall be as per Bill of Quantities.
- 5.03 The cement concrete chequered tiles shall be laid on concrete base complete as per instructions laid down on the drawings and as directed by the Engineer/Consultants.
- 5.04 The curing period of the setting bed shall be as directed by the Engineer. As large an area of setting bed shall be spread at one time as can be covered with tiles before the



mortar has set. Surplus mortar shall be removed. The thickness of setting bed in any space shall not be less than 1/2".

- 5.05 Floor and wall surfaces to receive the tiles shall be thoroughly cleaned of all dirt, dust, oil and other objectionable matters. Tiles shall be laid out from the centre line of each space in an outward direction and the pattern should be symmetrized with minimum number of cut tiles.

Joints between the tiles shall be of uniform width. Tiles shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to the straight edges.

- 5.06 After seven days the terrazzo tile floors shall be machine ground to a true even surface using various grades of abrasive stones as required and directed by the Engineer/ Consultants. After the first grinding the floor shall be grouted with the same colour and tint composition as used for its manufacture. The grout shall be of the consistency of thick cream and shall be brushed pressed over the floor to fill in the joints and after 72 hours the grouting coat shall be removed by grinding till a smooth and even surface is obtained. Area and portion of the floor inaccessible for the grinding machine shall be ground and rubbed by hand. The final gloss shall be given by polishing the surface to the satisfaction of the Engineer/Consultants.

- 5.07 Joints between the tiles shall be minimum width. Tiles shall be cut with an approved cutting tool and rough edges shall be rubbed smooth. Tiles shall be laid to straight edges.

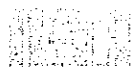
- 5.08 The tile floor should be kept wet for at least 72 hours and no one should be allowed to walk on the tiles during that period.

- 5.09 Freshly placed concrete floor shall be protected to prevent loss of water by covering with damp Hessian, waterproof paper, damp sand or other approved material, and shall be kept constantly damp for a period of four days or longer after concreting as directed by the Engineer/Consultants. The concrete shall be allowed to dry out slowly over a period of three days after wet curing is completed.

## **6. GRINDING AND POLISHING OF FLOOR**

- 6.01 The complete terrazzo floor shall be kept moist for 6 days there-after and protected from extreme of temperature.

The floor shall then be machine ground, using electrical or mechanical grinding to a true even surface using No.24 grit followed by a No. 80 grit or finer abrasive stone until the marble chips are evenly exposed. After the grinding the floor shall be



thoroughly cleaned using neutral cleaning materials. The floors shall then be grouted with same cement and colour composition as specified for the matrix. The grout shall be to the consistency of cream and shall be brushed over the floor to eliminate all imprisoned air. It shall be cured for 72 hours.

After 72 hours the grout shall be removed by grinding with 180 or 240 grit stones or other abrasives. If the surface still needs grinding, it shall be done similarly a second time and removed after 72 hours. The grinding should be adequate in as much as that the surface should show 70% of its area in exposed aggregates, evenly distributed and conforming in appearance to the approved samples. Small area in inaccessible portions which cannot be reached by machine shall be applied in strict accordance with manufacturer's directions.

The floor shall then be machine buffed. The use of acid in any form for any purpose will not be permitted.

7. TERRAZZO WORK CAST IN SITU FOR SKIRTING

White/grey cement shall be as specified in the Bill of Quantities. The work shall consist of a wearing surface of thickness as specified in Bill of Quantities of the grinding and polishing, of marble chips and cement, (of the specified colour) laid over a layer of cement sand mortar (1:3) of the specified thickness shall be applied on the wall for skirting and terrazzo topping of the specified thickness be applied over the base in the ratio 1:2 (one part of cement and two part of marble chips) grinding, rubbing and polishing etc. Complete as per drawings.

8. MEASUREMENT AND PAYMENT

The superficial area will be measured in square Meter for all items of work in this section except terrazzo skirting will be paid in Running Feet.



## SPECIFICATIONS FOR CERAMIC TILE WORK

### 1. SCOPE

The work covered by this section comprises of fixing in position glazed ceramic tiles on internal walls and floors wherever required on the drawings or Bill of Quantities.

### 2. CONFORMITY TO BRITISH STANDARDS AND CODE OF PRACTICE

Except as otherwise specified the following British Standards and Code of Practice shall be applicable to materials and fixing methods for ceramic tile work.

- i) British Standard 1281: 966 "Glazed Ceramic Tiles and Tile Fittings for Internal Wall".
- ii) British Standard C.P. 212 for fixing methods and workmanship.

### 3. JOINT FILLER

Joint Filler shall be white or coloured ceramic tile grout which shall bond to dry tile, shall be non-shrinking, stain resistant, permanent in colour, and shall not inhibit fungus and bacterial growth. It shall be odourless and non-toxic, of smooth consistency for easy preparation and neat rapid installation, and shall contain non-metallic material. Grout shall be water resistant and shall not wash out under water.

### 4. ADHESIVES

Adhesives for ceramic tiling as specified in the British Code of Practice C.P. 212 and of approved make and brand shall be used.

### 5. SAMPLES AND TESTS

The samples shall be furnished in sized and colours and adequate in number for testing in the Laboratory as and when ordered by the Engineer/Consultants.

### 6. SHOP DRAWINGS

The Contractor shall prepare shop drawings on the basis of drawings produced by the consultants for all the ceramic tile work to be carried out on the project. These drawings will show clearly the sizes, method of fixing, jointing and the anchorage to be used in the process and the Contractor shall get approval in writing from the Consultants well in time before the actual start of the work.

## WORKMANSHIP

- 7.01 Surface to receive the ceramic tiling shall be clean and free of dirt, dust, oil, grease or other objectionable matter. Setting beds and tile shall be installed with their respective surfaces to true plumb/planes, levels or pitched to off-sets as required by the drawings, so that the surface of the completed tiling work will be at the elevations and grades shown. retempering of mortar will not be permitted. Tiles shall be laid out from the centre lines of each space outward and adjustments made along wall, partitions and borders, if any, so as to symmetrize the pattern with a minimum of cut tiles.
- 7.02 Joints between the tiles shall be of minimum and uniform width and the same as the tile installed. Fractional changes in dimensions without varying the uniformity of joint widths will be permitted. Tile shall be cut with a suitable cutting tool and rough edges shall be rubbed smooth. Cut tile misfits shall be laid to the straight edges. Straight edges shall be accurately set to the lines established and reset at suitable intervals to keep the joints parallel over the entire area.
- 7.03 Scratch coats for application as foundation coats shall be not less than 1/4" thick and shall be composed by volume of 1 part grey portland cement to 4 parts dry sand, mixed with the minimum amount of water necessary to produce a workable mass. Mortar for scratch coats shall be used within one hour after mixing and retempering will not be permitted. Scratch coats shall be applied in sufficient quantity and with sufficient pressure to cover the entire area and to form good keys, shall be deeply scored or scratched and across-scratched, shall be protected and kept moist during the curing period, scratch coats shall be thoroughly damp-cured, and an interval or not less than 24 hours not more than 48 hours shall be permitted between application of scratch coats and application of float coats.
- 7.04 Joints shall be straight, level perpendicular and of even width throughout. Vertical joints shall be maintained plumb for the entire height of the tile work. Each tile shall be brought to true level and plane by uniformly applied pressure under a straight edge or rubber faced block. Tiles that are out of true plane or misplaced shall be removed and reset, damaged or defective tile shall be replaced. The tile shall be installed as follows:
- "Wall tile shall be set by trowelling a skim coat of neat Portland cement on the floor coat or by applying a skim coat to the back of each tile unit and immediately floating the tile into place. After tile has set, remove paper using a minimum of water. Replace damaged tiles".
- 7.05 After the tiles have been thoroughly set, joints shall be grouted full with a plastic mix of neat white or coloured water proof portland cement immediately after a suitable area of tile has been set. The joints shall be struck flush and excess mortar shall be cut off and wiped from the face of the tile. Interstices or depressions in the mortar joints after grout has been cleaning from the surface shall be roughened at

once begins to harden. The skirting and coves shall be solidly backed with mortar.

#### 8. MEASUREMENT AND PAYMENT

The ceramic tile work under this section shall be measured and paid by superficial area on which tile work has been carried out under respective items of the Bill of Quantities. The unit of measurement shall be per square meter. The rate for ceramic work shall cover the cost of furnishing all material, labour, scaffolding, appliances, tools and plants and performing all operations in accordance with specifications, drawings and instructions of the Engineer/Consultants for satisfactory completion and finishing of the work. No separate payment shall be made for producing samples of workmanship, tests to be carried out, preparation of working drawings, protection and maintenance of ceramic tile work as specified and the rates for construction items shall be deemed to be inclusive of all such costs and charges.



## SPECIFICATIONS FOR FINISH HARDWARE

### 1. SCOPE

The work under this section includes furnishing of all plant, labour material, equipment & services necessary for detailing, fabricating & delivering all hardware, complete as indicated on drawings and / or as specified herein or both.

### 2. GENERAL REQUIREMENTS

- a) Material of door & frames, size and kind of door, shall be as indicated on the door schedule or in detail for exterior or special door. Hand of door shall be verified on plans.

b) Manufacturer's product

Where Manufacturer's product are specified, the product of other Manufactures, equal to the product specified may be used provided the Engineer/ Consultant approval is obtained as follows:-

Showell and Union are acceptable in place of Yale Europe for numbers specified.

c) Modificaitons

All modifications in hardware, required by reason of construction characteristics, shall be such as to provide the specific operation of functional features required.

d) Application on Metal

Metal surfaces to receive hardware shall be suitable prepared by having the holes, for fastening placed in accordance with a template furnished by the hardware Manufacturer.

e) Fastenings

Hardware furnished under the specifications shall be complete with all necessary screws, bolts trim, or other fastening for proper application. Such fastenings shall be of suitable size and type, and shall harmonize with the hardware as to material and finish.



### 3. SAMPLE SCHEDULE & SAMPLES

As soon as practicable after award of contract, and before a final hardware schedule is prepared or any hardware delivered to the project site, the Contractor shall submit to the Engineer/ Consultant for approval sample schedule listing each of the different items of Finish Hardware proposed for use. The sample schedule shall be submitted in the following form:-

Item No.	Specification Reference Type or Catalogue No.	Name of Item	Manufacturer's Name and Cat. No. of Item supplied.
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Opposite each listed Item No., insert the Specification Reference, the name of the item and the Manufacturer's name & Catalogue No. of the item to be supplied. Where the listed item is not illustrated in the Manufacturer's Catalogue, occurred and descriptions, or shop drawings shall be submitted with the hardware schedule. In addition to the sample schedule, a sample of each different item of the builders hardware, properly tagged and marked for identification shall be submitted to the Engineer/ Consultant for approval.

### 4. HARDWARE SCHEDULE

After approval of sample schedule, hardware supplier is to finish a final schedule or finished hardware showing door number, door size & thickness, material or door and frame & hand of door, schedule is to detail all hardware to be used at each opening including material, finish and kind of all elements showing locks, latch or passage set, times, dummy trim, hinges, closers or spring hinges, silencers, pulls, kick & push plates, thresholds, stops, holders and type & kind of screws, etc.

Approved samples of the various hardware items may be installed in the work, as last item of work, provided a permanent record of their exact location is furnished to the Engineer/ Consultant.

### 5. TEMPLATES, MARKING & INSTALLATION INSTRUCTIONS

After approval of schedule supplier is to furnish templates to Manufacturer (s) of hollow metal doors and frames, installations instructions, diagrams and templates are to be furnished to the Contractor as well as all special tools necessary for installation and adjustment.

All hardware is to be delivered in sealed cartons containing all necessary screws. Cartons shall be clearly marked as to type so as to be readily identifiable as related to specific door with the use of the schedule.



6. KEYING

Three keys shall be supplied for each lock with the lock number stamped on face and corresponding number stamped on face of lock. A rekeying kit and 500 blank keys are to be supplied by each separate major lock Manufacturer. All locks are to be keyed differently except as follows:-

- a) Mechanical equipment rooms and these rooms exclusively used for airconditioning, heating, or ventilating equipment are to be separately master-keyed.
- b) Electrical rooms, transformer rooms, generator rooms, panel rooms, Electrical closets and those rooms used exclusively for Electrical equipment are to be separately master-keyed.
- c) No locks are to be grand master-keyed.
- d) No locks are to be keyed alike.

Three master-keys shall be furnished for each master-key system. After all locks have been installed and upon completion of the work the keys shall in the presence of Engineer's Representative be shown to operate their respective locks and shall be tagged with door numbers stamped on an aluminum disc 1/4" in dia, and delivered to the Engineer's Representative who will furnish a receipt.

7. SHOP DRAWINGS AND DETAILS

Cuts and dimensions of all hardware and samples of finish are to be supplied for approval with the schedule.

All hardware items to be manufactured locally and not stock items are to have shop drawings submitted for approval before fabrication.

8. GUARANTEE

All parts broken during one year guarantee period not caused by misuse shall be replaced by the Contractor at no extra cost to the CDA.

9. SAMPLES

Samples of all kinds of materials to be used on the job, shall be submitted to the Engineer/ Consultant and to be approved by him.

10. TESTING

All materials and samples shall be subject to standard specification such as A.S.T.M. or B.S.S. or its equivalent shall be rejected. Rejected materials shall be removed from the site immediately.



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## SPECIFICATIONS FOR PAINTING AND POLISHING

### 1. SCOPE

The work under this section includes the following items:

1.01 Painting of plastered and cement surfaces.

1.02 Painting of wood work and steel work.

1.03 Polishing of marble and terrazzo works.

1.04 Polishing of wood work.

### 2. CONFORMITY TO BRITISH CODE OF PRACTICE

Except as otherwise specified, all painting shall be applied in conformity with C.P. 231 "Painting" as applicable to the work.

2.01 Polishing of marble and terrazzo works shall be carried out in accordance with standard practice for these trades.

2.02 Wax and French polishing of wood shall be carried out by expert craftsman of these trades.

### 3. MATERIALS

Paints for exposed concrete surface shall be plastic paints of the Acrylic group suitable for exterior and interior painting. These shall be the products of the highest quality manufactured by BURGER/DULUX Brand and samples of work will be approved by Engineer/Consultants.

The material in the required quantity as calculated from Bill of Quantity shall be brought to Site in original un-broken packages bearing the maker's name and brand. Materials shall conform to the applicable British Specifications and shall be used in accordance with the manufacturer's printed directions.

#### 3.01 Paint for Steel Works

Paint for Steel Works shall be of high grade rust proof lead based products of



reputed manufacturers.

3.02 Paint for Wood Works

Paint for Wood Work shall be of high grade enamelled product of approved manufacturers.

3.03 Cement Based Paints

Cement based paints shall be obtained in sealed tins from approved manufacturers. It shall be delivered on the work in original and sealed packages bearing the maker's name etc.

3.04 Wax Polish

Wax Polish shall be as approved by the Consultants.

3.05 Spirit Polish

Spirit Polish shall be of approved quality.

4. SAMPLES AND DETAILED APPLICATION SPECIFICATIONS

Certified data, test samples and detailed application specifications shall be submitted for approval of the Consultants. The detailed application specifications, when approved by the Consultants will become the approved application specifications.

5. PREPARATION OF SURFACE

5.01 All surface shall be clean, dry and free from dust at the time any coating is applied. Base coats applied shall be in good condition and surfaces well covered by touching up any base or abraded spots. Base coats shall be rubbed smooth.

5.02 Wood Work

Wood work shall be smooth and free from raised grain or other surface imperfections. Knots and pitch steaks shall be shellacked before polishing. Nail holes, cracks and similar blemishes shall be neatly puttied and sanded smooth after priming and before body or finish coats are applied.



the Contract, or answerable for any default or omission on the part of the Employer in the observance of the provision of the contract or performance of any of the set matters or things which are herein contained.

Add the following sub clause:

**84. Freight Charges, etc.**

The Contractor shall pay all freight charges and expenses in connection with the transporting of materials, Plant and other things from the port of importation to the Site and from the Site to the port of exportation.

Add the following sub clauses:

**85.1 Accidents**

The Contractors shall within 24 hours of the occurrence of any accident at or about the site or in connection with the execution of the Work report such accident to the Engineer and the Employer.

**86.1 Laboratory Test and Testing**

All, testing including collection of samples shall be performed by an approved testing agency as proposed by the Engineer and at no extra cost to the Employer.

**86.2 Payment**

Payment shall constitute full compensation for all of furnishing necessary labour, materials, equipment and its maintenance and incidentals, for the proper completion of the work, as directed by the Engineer. The cost of provision of laboratory equipments, maintenance and its staff as indicated above shall be deemed to be covered within quoted rates of other items of Bill of Quantities.

**87 Transport Facilities**

**87.1** The Contractor shall be responsible to provide Transport facility free of cost to the Client/ Consultant representative/ Engineer etc. whenever needed/ required to from the Site.

**87.2** The prices for the above are to be included in the rates while quoting the Tender price..



### 5.03 Cement Based Paint

Plastered or concrete surface shall be cleaned until free of all loose and foreign material and excess mortar, using metal scrapers and wire brushes if necessary. Grease and oil spots shall be removed by suitable cleaning compound and then rinsed with clean water to remove all traces of alkali. Efflorescence (alkali salts) shall be removed by washing with a 5 to 10 percent solution of muriatic acid, allowed to remain until efflorescence ceases, then rinsing with clean water to remove all traces of acid. Interior concrete or plastered surface shall be washed with zinc sulphate solution. Treated surfaces shall be allowed to dry thoroughly before any paint is applied. Plaster work shall dry for a minimum of sixty days prior to distempering or applying any cement based paint. Surfaces shall be clean and free from grit, loose plaster and surface irregularities before distemper or cement based paint is applied. Ferrous surface that have not been shop-coated shall be cleaned and painted with protective paint conforming to British Standard Specifications B.S. 2521/4 followed by finish coat. Shop coated metal shall be protected from corrosion before and after installation by treating corroded areas immediately upon detection.

### 5.04 Emulsion Paint

Efflorescence due to salts crystallizing on the surface should be removed by repeated brushing. They can also be removed by a coarse damp cloth. It should be made sure that all the salts have been removed and not burnished.

Remove all grit, grease, dirt, loose material and like. Out cut and fill with approved patching materials, scratches, cracks, holes and similar defects in affected surfaces, patches portions shall be given a Prime Sealer in addition to specified coats. Large cracks are to be cut out with the edges undercut, and filled with approved grouting material, the edges being closely knit, and the filling level with surrounding surface.

## 6. PAINTING ON EXPOSED CONCRETE SURFACES

The work of application of plastic painting to exposed surfaces of concrete shall be carried out only after the final finish of exposed concrete surfaces has been accepted by the consultants.

- 6.01 The acrylic paint shall be sprayed with paint sprayers or applied as instructed by the manufacturer of the product. The number of coats for application shall be as specified in the Bill of Quantities, or as directed by the Consultants.



## 7. CEMENT BASED PAINTING ON PLASTERED SURFACES

- 7.01 No further material shall be added to the cement based paint obtained in sealed tins. Where different colours may have to be mixed together to provide the desired shade, the quantities of the various colours required to give the desired shade shall be intimated by the Consultants and this shall be mixed together by weighing (not by measuring volumes of different colours). The weighed quantities of cement based paint should be mixed on board after which it must be sieved through 200 mesh sieve. This preparation i.e. mixing with trowel and sieving may have to be repeated two or more times until when cement based paint of various colours, no signs of streakiness or any trace of separate colour remains.
- 7.02 Cement based paint must be mixed in two stages. First by adding a little quantity of water to form a paste and the further quantity of water being added to get a mix of workable consistency. In the first stage, one measure of water to two similar measures of cement based paint must be thoroughly stirred and allowed to stand for 10 minutes.
- 7.03 A further measure of water should then be added and thoroughly mixed. This mix must be applied within one hour of the mixing. The lid of the container must be tightly replaced immediately after the material has been taken out from it. Immediately before the first coat is applied surface shall be thoroughly saturated with water. The cement based paint should be applied with brushes conforming to British Standard 2992. The first coat of cement based paint shall be well scrubbed and allowed to set for a period of 24 hours, after which period the next coat shall be applied. The number of coats shall be specified in the Bill of Quantities but if the Contractor has not produced finished surface to the satisfaction of the consultants he shall be required to apply more coats till a uniform smooth surface is obtained at no expense to the employer.

## 8. EMULSION PAINT

Emulsion paint shall not be applied until after the plaster or concrete work or concrete work is thoroughly dry, which shall in no case be less than 3 months. If the efflorescence due to salt has been removed with a damp cloth, at least a week should elapse after this treatment.

The surface shall first be prepared in the manner specified hereinbefore. The priming coat shall then be applied as per the printed instructions of the



manufacturers. The priming coat shall be tinted to approximate shade of final coat.

First coat of emulsion paint shall be applied thinned with water as per manufacturer's directions generally 1/3rd the volume.

After first coat has thoroughly dried, second coat shall be applied as per manufacturer's directions, generally thinned with 15-20% of its volume with water. Third coat shall be similarly treated. Immediately after the coat of paint has been applied, it shall be inspected and if found unacceptable, it shall be recoated without any extra cost. Contractor shall notify the Engineer/Consultants for each coat applied when completed for inspection.

Each coat of paint shall be thoroughly sanded smooth to obtain the required finish. If the surfaces are not satisfactorily finished in the number of coats specified, additional coats of paint shall be applied without any extra charge to produce a satisfactorily finished in the number of coats specified, additional coats of paint shall be applied without any extra charge to produce a satisfactory finish.

## 9. POLISHING OF MARBLE AND TERRAZZO WORKS

The polishing of marble and terrazzo work shall be carried out, when the final surface finish of these items of work have been approved and accepted by the consultants.

- 9.01 The surfaces before application of wax or polish shall be washed with hot water and soft soap, and allowed to dry for receiving final treatment. The polished surfaces shall be kept clean and protected from dust and stains till final handing over to the Employer.

## 10. WAX OR POLISHING TO WOOD WORK

### 10.01 Wax Polishing

Before wax polishing is started, the surface shall be knotted stopped and sand papered till a complete smooth and even surface is obtained.

The wax polish must be applied strictly in accordance with the specifications and instructions issued by the manufacturers. It shall contain minimum of colouring material to keep the finished surface as light as possible. The polish shall be rubbed into wood until all the pores have disappeared.



10.02 Spirit Polishing

It shall be prepared by taking 3 ounces of shellac, dissolved cold in a pint of spirit and shall be applied on the prepared surface as specified under wax polishing.

11 PAINING OF TIMBER AND METAL SURFACES

Paints and finishing materials shall be free from skins, lumps or any foreign matter when used. Pigments and fillers shall be kept well stirred while being applied. Work that is not to be finished under this section shall be protected against spatters, stains or soiling and each type of finish shall be protected against similar defacement by other finish and shall be left clean.

12. CLEANING

All cloth and cotton waste that might constitute a fire hazard shall be placed in closed metal containers or destroyed at the end of each day. Upon completion of the work all staging, scaffolding and containers shall be removed from the site or destroyed in an approved manner. Paint spots, oil or stains upon adjacent surfaces shall be removed. The Contractor shall be responsible for the protection arrangement of the work while painting or polishing work is in progress.

13. MEASUREMENT AND PAYMENT

- 13.01 The polishing of marble and terrazzo works shall not be measured separately, but it shall be included in the rate of these items under respective items in Bill of Quantities. The polishing of wood shall be deemed to be included in rate of wood work and no separate payment shall be made for the wax or French polishing.
- 13.02 The rate for wooden doors and windows shall include the cost of painting or polishing as specified in the Bill of Quantities and no separate payment shall be made for work under this section.
- 13.03 The rate for steel doors, shutters and railing shall be inclusive of painting as specified in the Bill of Quantities and no separate payment shall be made for the painting work. Cement based painting on concrete and plastered surfaces shall be paid for on the basis of area over which they are done and this area shall be



obtained by multiplying length by breadth or height less the area of openings for doors and windows in the surface. The unit of measurement shall be 100.

- 13.04 Plastic painting of exposed concrete surfaces shall be measured and paid for on the basis of superficial area covered and for required number of coats applied as directed by the Engineer/Consultants.
- 13.05 Deductions shall be made for area of openings of any size for respective surfaces to be treated, while area for jambs, soffits, sills etc. shall be added in the surface area. The rate for all the items under this section or paid for with items in other sections, shall cover the cost of furnishing all materials, labour, scaffoldings and appliances at site and performing all operations in accordance with instructions of the Consultants Bill of Quantities and as specified above.



## SPECIFICATIONS FOR WATER PROOFING AND INSULATION

### 1. SCOPE OF WORK

The work covered by this Section of Specifications consists of furnishing all plants, labour, appliances and materials in performing all operations in connection and the applicable drawings as required in Bill of Quantities and subject to the terms and conditions of the Contract.

The work under this Section shall include the following:

- (a) Water proofing and Insulation of the roof in accordance with the specifications, as required by Bill of Quantities and drawings.
- (b) Application of Bituminous paint as per Specifications and as required by Bill of Quantities and Drawings.
- (c) Water proofing of Basement walls and base using cold applied self adhesive membrane as per Specifications.

### 2. CONFORMITY TO STANDARDS

All insulation and water proofing works shall conform to relevant standards as applicable to the work as specified therein. Except otherwise specified, the work of water-proofing shall comply with B.S.C.P. 144 roofer covering "Part-I built up roofer and Part-II Master Asphalt" as applicable to the work as specified and shall also conform to related ASTM wherever applicable.

### 3. MATERIALS

Materials shall be delivered to the site in manufacturer's original container, with manufacturer's label bearing type, grade and name of quality etc. clearly marked thereon. A copy of printed instructions from manufacturer shall be supplied to the Consultants.

- (a) Cement shall conform to specifications described under Section "Concrete Work".
- (b) Water shall be as described under Section "Concrete Work".
- (c) Primer shall be "Impertene Primer" or equivalent as approved by the Engineer/ Architect.



- (d) Sand shall be as specified under Section "Plaster".
- (e) Gravel shall be 1/4" to 1/2" size and shall be washed, free of dust, soil or foreign material and 100% passing through 1/2" screen and dried.
- (f) Xypex/Vandex etc. shall be water-proofing compound based on crystallization method.
- (g) Insulation material shall be expanded polystyrene (Thermopore) board of 2lbs/cft density of the type as approved by the engineer, conforming to BS 2972: 1961 or WOODCEP as manufactured by HARAMAN conforming to the following specifications:-

Panel Size Thickness mm	Width mm	Length mm
18	505	2000
25	"	2000/2500
30	"	"
50	"	"
75	"	"

\* Density:

360 to 450 Kgs/cubic meter    Moisture  
contents after curing: 9 to 12%

\* Thickness swelling after 28 days in water.  
Maximum 0.2%

\* Thermal Conductivity:  
0.1 Watt/square meter degree C/Hour.

\* Flexural Strength:  
50mm panel = 0.5 N/mm.sq. = 70 Psi.  
75mm panel = 0.4 N/mm.sq. = 56 Psi.

\* Compressive stress at 10% crushing:  
30mm panel = 0.2 N/mm.sq.  
30mm panel = 0.15 N/mm.sq.

\* Sound Insulation.





50mm thick panel plastered.....	= 36.40 dBs
Twin leaf wall with air cavity.....	= 57 dBs
Twin lead wall with a concrete core of 120mm thick.....	= 54.56 dBs

\* Fire Resistance:

Class 'O' to BS 476

50mm panel un-plastered = 1 hour.

50mm panel plastered = 2 hours.

Class B 1 (Non-ignitable) DIN 4102 part 1.

\* Water Resistance:

No deterioration shall take place while immersed in water.

\* Fungi resistance:

Resistant against dry rot and fungal growth and also impervious to vermin.

\* Termite Proof : Product shall be protected chemically against Termite attack.

(h) Water Proofing Compound ZSAC-10/55 sealing adhesive coat as manufactured by ZAHABIYA CHEMICAL INDUSTRIES or equivalent as approved by the Engineer shall be water proofing free flowing compound with water proof, vapour barrier, Abrasion resistant and non-cracking properties confirming to ASTM. D-1729, D-1833, D-2507, D-1475, D-1644, D-3278 & FSTM-72.

(i) Modified Asphalt Membrane A modified Asphalt membrane "Paralon"/Dermabit or equivalent 4mm or 2mm thick single ply shall be used for water proofing in basement/roof treatment, as approved by the Engineer/Architect. It shall conform to relevant ASTM and BSS. It also deemed to be included primer "Impertene" as per manufacturer instructions etc.

(j) Rockseal 110 - Water based Rubberized adhesive cum sealant in paintable consistency.

#### 4. SAMPLES

The Contractor shall get samples of all the material used for the items under this Section approved by the architect and the same type of materials shall be used throughout the work.

Any materials required by the Architect to be tested, shall be got done by the Contractor at his own cost from the Laboratory approved by the Consultants.

#### 5. WORKMANSHIP



(a) **General**

For basement slab and wall a 4 mm thick membrane shall be used with proper overlaps as specified hereinafter and corners shall be provided with double layer.

The vertical membrane shall be protected with polystyrene matters.

The water proofing of roof shall be done with 2mm thick "Paralon"/Dermabit membrane over a layer of "Impertene" primer and/or using xypex/Vandex two layer treatment as per manufacturer's specifications and ZSAC-10 sealing Adhesive Coat as manufactured by ZAHABIYA CHEMICAL INDUSTRIES or approve equivalent.

(b) **Surface Preparation**

All surfaces to receive water-proofing shall be cleaned and perfectly dry. All pits, holes shall be filled up with mastic and all high spots chipped off and ground smooth and the surface carefully swept clean to the satisfaction of the Architect Incharge. Contact surface receiving water-proofing shall be dry to the satisfaction of the Consultant.

(c) **Roofing Using Bituminous membrane (Paralon/Darmabit)**

Built up roofing on the roof shall consist of the following:

- (i) The surface of the concrete slab or screeding shall be cleaned with brooms to remove all loose particles and then "Impertene Primer" shall be applied with long handled brush.
- (ii) After drying the primer, a 2.6 mm thick "Paralon" asphalt membrane shall be laid with overlap of 8 CM and shall be flame bonded. The layer shall be extended vertical height. An extra layer of 1M wide membrane shall be laid in the corner of parapet and slab shall be totally flame bonded to the pre-laid layer.
- (iii) The two layers shall be fixed to the parapet wall as directed by the Engineer/Consultants with a aluminium strip and nuts and bolts.
- (iv) Over Paralon provide one layer of 50mm thick heavy duty expanded polystyrene sheets (Thermopore). It shall be stucked use cold applied sticker of approved make.
- (v) Finally the surface of the Paralon covered with thermopore sheet shall be covered with 0.2mm thick polythene sheet before laying any type of flooring.



- (vi) Providing and laying flooring/screeding to required slope as shown on drawings. The thickness of screeding shall be 13mm to 37 mm laid in panels without gap or expansion joints.
- (d) Roofing Surface Treatment Using Xypex/Vandex
  - (i) Crystalline water proofing material in powdered form shall be mixed with water in specified ratio for application as cementitious slurry coating on concrete surface or as a "DRY PACK" for sealing the construction joints and repair of cracks.
  - (ii) Slurry shall be applied to properly treated concrete surface as per manufacturer's specification, also the surface shall be thoroughly wetted.
  - (iii) Two layer application shall be done using 2.0 lbs of material/ Sq.yds of surface i.e. 3 part of powder to 1 part of water.
  - (iv) One coat shall have thickness of just under 1/16" (1.2mm), when second coat is applied, the first coat should have reached an initial set but is still "green" (less than 48 hours) light pre-watering between coats may be required due to drying.
  - (v) Treatment must not be applied in rain or during freezing condition.
  - (vi) Curing with water must continue for 2-3 days.
  - (vii) Providing and laying flooring/screeding to required slope as shown in drawing.
- (e) Roofing using ZSAC-10/55.

Sealing adhesive coat (ZSAC-10/55) should be applied over the surface, receiving water proofing as per the following specified method.

- (i) Application of First primer coat diluted with 20% water so as to cover approx. 100 Sft. surface area when mixed with 2 Kg. of ZSAC-10/55 compound.
- (ii) Application of 2 coats of ZSAC-10/55 of uniform thickness so that 100 Sft. approx. shall be covered by 2.5 Kg. of ZSAC-10/55 for each coat.
- (iii) Fixing of polymeric canvas of 10 oz/sq.yd. by weight impregnated



with 3 coats of ZSAC-10/55 to obtain minimum 15-16 oz.sq.yd. by weight.

(iv) Application of Final protective single coat as per step No.(ii).

(f) Roofing Using Rock Seal 110

(i) Rock Seal 110 - One component Water based Rubberoid adhesive cum sealant formulated in paintable consistency.

(ii) The surface of the existing concrete shall be cleaned by removing all dirt, grease, oil and chemical residues using hard brush sand blasting/pneumatic scale remover. All loose, cracked and crumbling materials shall be removed.

(iii) First coat shall be applied on fresh cement concrete/plaster using little low viscous (thin) mixed with 6% to 10% distilled/ previously boiled and cooled water by weight.

(iv) Second coat shall be applied after 6 to 12 hours at ambient temperature of 30 C to 40 C.

(v) Third coat shall be applied similarly as second coat.

(vi) The temperature limit for application of Rock Seal 110 ranges from 8 C to 85 C.

(vii) Providing and laying roof screeding over Rock Seal 110 to required slope and thickness as shown in drawing.

(g) Roofing Using local Quality Bitumen Felt

Following treatment shall be done successively over properly cleaned concrete surface:

(i) Apply cold sticker of the approved make at the entire surface at the rate of 25 Lbs % Sft.

(ii) Hot sticker of approved make shall then be applied at the rate of 30 Lbs % Sft.

(iii) Lay 2 Ply Bituminous Roofing felt of approved quality.

(iv) Lady flood coat of Bitumen PB4 heated to 375 F at the rate of 50 Lbs



% Stt.

- (v) Over the flood coat P-gravel at the rate of 2 Cft per hundred square feet is laid and tamped.
- (vi) Providing roof screeding over Bitumen Felt to required slope and thickness as shown in drawing.

(h) Application of Waterproofing Membrane for Basement

(i) Priming

- (1) The surface of concrete screed for laying water-proofing membrane shall be smooth and well trowelled. The area required for water-proofing shall be clear 1 Meter larger than the building expected outside line.
- (2) The surface shall be in dry condition before laying primer and a suitable weathering time shall be selected for laying water-proofing.
- (3) The "Impertene Primer" shall be applied on the screed after brooming the surface. All loose particles shall be removed from the screed surface. Primer shall be applied with a long handle brush.
- (4) The priming shall be applied upto the expected outer line of the building.
- (5) The primer shall be left for dry before laying asphalt membrane "Paralon NT4".
- (6) The area shall be strictly watched to avoid under priming. The application of primer shall be done thoroughly and smoothly.

(ii) Laying of Membrane (Paralon NT4)

- (1) When "Impertene Primer" is dry, a Paralon layer shall be bonded to the primed surface. The Paralon layer shall be kept 1 Meter larger than the building line for vertical overlaps on each side of the base floor.



- (2) The adjacent layer shall be overlapped 10 CM on the other and shall be bonded by flame, as per instruction of manufacturer of "Paralon" or as directed by the Engineer/Consultant. The bonding shall be carefully checked to avoid any seepage thereafter.
- (3) The larger portion left outside shall not be bonded, this shall be left loose.
- (4) A 1 meter wide extra strip of Paralon NT4 shall be laid out entirely loose around the expected building parameter. The same shall be laid to reinforce the corner between horizontal and vertical wall of building. Half of the 1 Meter strip will be under the base floor and half will be bent vertically with walls.
- (5) A 3 to 4 inch thick cement concrete (to be paid separately) shall be laid over the horizontal/sloping waterproofing surface and this shall not be exceeded the outline. The outer corner shall be rounded to avoid the squashing to the Paralon sheets during upturning afterward.
- (6) After construction of base slab and vertical wall, the surface shall be treated with "Impertene Primer" with a long handled brush upto the required level.
- (7) After drying the "Impertene Primer" the two "Paralon NT4" pre-laid layers in the bottom shall be upturned and totally flame bonded, the 1st one to the wall and 2nd one to the 1st one.
- (8) "Paralon NT4" shall then be laid out to all vertical walls, totally flamed bonded and with at least 10 CM overlappings and started from the bottom of up turned edge. The Paralon NT4 sheets shall be strapped at the top, that is fixed to the concrete or cc block wall by means of aluminium strips and nails as per direction of the Engineer/Consultants.
- (9) The aluminium strip shall be covered by a Paralon NT5 strip which shall be carefully flame bonded, paying attention that no empty spaces are left.

During all the processes, it is necessary to keep the area dry through a continuous dewatering to keep the water table below the working levels.

(i) Insulation Laying.

- a) 2" to 3" thick expanded thermopore sheet of required size and density shall be fixed to the surface receiving insulation as per drawing/B.O.Q, using cold applied polymeric base adhesive. The sheet shall be enclosed in an Air/Water tight 0.2 mm thick polythene.
- b) 50mm (2") to 75mm (3") thick woodchip panel of specified/approved sizes shall be laid on cement mortar as per B.O.Q. Details while the mortar is still green or the woodchip panel shall be loosely laid in staggered joints panel and shall be fixed to the surface using suitable fixing mechanism as approved by Engineer.

6. **GUARANTEE**

(a) **The Bond**

The Contractor shall furnish a bond, which shall be agreed upon in the Contract, to insure the successful performance of the Water Proofing/Insulation work, and he shall agree that there is nothing in the above specification which will prevent such successful performance. The bond shall be for a period of 10 years.

(b) **Repairs**

If any leaks appear within a period of 10 years after the work is done, the Contractor shall be obligated, at his own expense, to repair them by removing the cost at the point of leakage, roughing the concrete, and applying a new coat. The Contractor shall relieve the pressure while making repairs. The Contractor shall not be responsible for any defects caused by setting or other structural causes as per decision of Engineer.

7. **MEASUREMENT AND PAYMENT**

Measurement for waterproofing damp proofing and Insulation shall be per square meter/sft. of area treated. The rate for specific number of layers/treatment shall include preparing surfaces, all materials and labour, equipment, heating and all operations required to complete the work in all respects to the satisfaction of the Architect and as specified. The rate shall also include all labour and materials, scaffolding if necessary, overlaps, galvanized nuts, bolts, washers, ridgers and hips etc. to complete the job. It shall include cost of concrete where applicable in respective BOQ item. Asphalt, Polystyrene sheet, screed, Prime, Asphalt Membrane etc.

SPECIFICATIONS  
ELECTRICAL WORKS





## SECTION -E - 1 GENERAL SPECIFICATIONS

### FOREWORD

This document is to describe the minimum requirements for the equipment and installations and to ensure that the Contractor is fully aware of his duties to perform the required works, in accordance with the terms of the Contract.

### 1.0 SCOPE OF WORK

The works related to the electrical system which are included in the scope of this Contract are shown on the Drawings, stated in the Particular Specifications, Bill of Quantities and explained in these specifications. The works shall broadly include but not limited to the following:

1. Low Voltage Switch Boards / Distribution Boards (Section -E - 2)
2. Low Voltage Cable and Wires (Section - E - 3)
3. Conduits and Pipes (Section - E - 4)
4. Wiring Accessories (Section - E - 5)
5. Interior Lighting Fixtures (Section - E - 6)
6. Cable Tray, Ladder and Trunking (Section - E - 7)
7. Addressable Fire Alarm System (Section - E - 8)
8. List of Approved Manufacturer (Section - E - 9)

All material and equipment supplied by the Contractor shall be new and in all respects conform to the high standards of Engineering design, workmanship, performance and function as here in specified and fully meet the quality level and rugged requirements of the specifications.

The Contractor shall also be responsible to supply any other equipment not specifically mentioned in these documents but which is necessary for proper operation of the works / system, shall be considered to have been so specified and accordingly shall be provided by the Contractor as part of the Contract.

The Contractor shall be solely responsible for ensuring proper functional requirements of various equipment and shall also be responsible for furnishing any additional piece of equipment and for making modification in the equipment as desired and / or approved by the Owner or his representative, to achieve proper coordination with various equipment offered in the bid and also those installed by others.

Approval of the Contractor's supplied equipment / installation works shall not relieve the Contractor of any of his obligations or liabilities under the Contract, except insofar as provided under the conditions of the Contract.

### 2.0 RULES AND REGULATIONS

The entire electrical installation / work shall be carried out by licensed



contractor, authorized to undertake such work under the provisions of Electricity Act 1910 and The Electricity Rules 1937 as adopted and modified up to date by the Government of Pakistan.

All works shall be carried out in accordance with the latest edition of the Regulations of the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers - London, the Contract documents, the Electricity Rules 1937 and bye-laws that are in force from time to time. Any discrepancy between these specifications and any other rules and regulations shall be brought to the notice of Owner or his representative, and his decision shall be final and conclusive.

The Contractor shall be responsible for completing all formalities and submitting the test certificates as per prevailing rules and regulations and shall have the installation passed by the Government Electric Inspector of that region. All requirements of the Electric Inspector and the Electric Company shall be complied with.

### 3.0 STANDARDS

All works, equipment and materials shall conform to:

On the one hand:

The specification recommended practices, official standards and codes the non-restrictive List of which is given below.

International Electro-technical Commission (IEC)

British Standards (BS)

National Electric Code (NEC)

National Standards

In the event of conflict between standards, the most stringent shall prevail.

Whenever the electrical equipment to be installed, does not hold national standards, the Contractor shall take into account the specific standards chosen by the Owner and make sure that the equipment he has to install, meets these standards.

In addition, even if no mention is stipulated in this specification, it is implied that the equipment be tropicalized, if required, by the conditions of the site of installation.

In any case, the standards and codes to be taken into consideration are those in force at the date of delivery.

### 4.0 INSTALLATION AND SERVICE CONDITIONS

#### 4.1 Site Conditions

All material and equipment supplied and installed shall be designed, manufactured and tested to meet the following ambient conditions unless specifically stated otherwise for any material / equipment:

- a. Maximum outdoor ambient temperature: 45 degree C



- b. Minimum indoor ambient temperature : 0 degree C
- c. Maximum relative humidity : 90 %
- d. Minimum relative humidity : 26 %

#### 4.2 Service Conditions

Equipment shall be designed and built for continuous service with a minimum of supervision and maintenance.

### 5.0 MAIN ELECTRICAL CHARACTERISTICS

#### 5.1 Power Supply System

Unless otherwise specified elsewhere, all equipment and material shall be designed to operate and function satisfactorily with the following minimum requirements without any derating:

- Voltage 400  $\pm$  10%
- Phase 3, 4 wire system
- Frequency 50 Hz  $\pm$  2 Hz.

#### 5.2 Degree of Protection of Enclosures

For indoors, IP31 minimum degree of ingress protection of the enclosures against contact with live or moving parts and against ingress of solid foreign bodies or liquids, shall be selected, in accordance with IEC 60529.

### 6.0 GUARANTEE

The Contractor shall furnish written grantee which should clearly state that the works he will carry out as well as the materials he will supply, meet with this specification and that compliance thereto constitutes an official clause, added by implication to the general conditions of his offer when signing the Contract.

Guarantee shall also be for replacement and repair of part or whole of the equipment which may be found defective in material or workmanship. The grantee shall cover the duration of Maintenance Period as defined in the conditions of the Contract. This guarantee shall not relieve the Contractor of his obligations and he will fully be responsible for the repair or replacement of any defective material in time, so as not to cause any undue delay in carrying out the repairs and/ or replacements.

The Contractor shall acquaint himself fully with the existing conditions and limitations at site and all works necessary to complete the project under the Contract, to be carried out by the Contractor.

### 7.0 EXCEPTIONS TO SPECIFICATION

Any exception or deviation from this specification or the codes and standards shall be listed separately in the Contractor's "List of Deviations". Any exception, which shall not be listed, shall not be considered later.

### 8.0 AVAILABILITY OF SPECIFICATIONS, DRAWINGS AT SITE

The Contractor shall assume at his own cost the permanent availability of this specification and drawings on site where applicable.

**9.0 DISCREPANCIES IN TENDER DOCUMENTS AND DRAWINGS**

The Contractor shall carefully examine the documents and drawings and if he finds any discrepancies or omissions from the specifications, bill of quantities or drawings, or is in doubt as to the meaning, he shall at once notify the Owner or his representative for receiving his instructions before proceeding with the works. If such defective or modified work is carried out by the Contractor on his own, he shall rectify the same at his own cost.

**10.0 MEASUREMENT OF WORKS**

The quantities set out in the bill of quantities are the estimated quantities and they shall not be taken as actual and correct quantities of work to be executed by the Contractor. The Contractor shall carry out actual measurement of works at the site.

**11.0 INSTALLATIONS DETAILS**

The locations, routings, installation heights, detail etc. for electrical equipment are indicated on the drawings. If any information is not stated on the drawings or wherever modifications are required the Contractor shall obtain prior instructions from the Owner or his representative.

**12.0 DRAWINGS AND DATA**

The Contractor shall provide dimensional, outline drawings, arrangement drawings and technical data for the equipment offered, for the approval of Owner or his representative.

**13.0 PRIOR APPROVAL OF SHOP DRAWINGS, MATERIALS AND EQUIPMENT**

The Contractor shall provide shop drawings for the electrical installations showing the exact routes of all underground cables and ducts, the exact run of all conduits and trunking, draw-in and junction boxes, the number and size of wires in each conduit, the final connection arrangements at distribution boards and the details of ducts for the approval of consultant / Owner's representative before commencing any portion of the works. All such working drawings shall be submitted in suitable number of copies as indicated in the particular conditions and within the periods stipulated below:

**a. Cable entry ducts into buildings:**

Working drawings shall be submitted within two weeks of handing over the site.

**b. All other working drawings shall be submitted to the Engineer against signed receipt and dated within two months of signing the Contract. Should however the Contractor be obliged to install electrical conduits prior to this period then he shall submit the relevant working drawings at least two weeks prior to the proposed date of commencement of the work. The Contractor shall submit the program indicating the dates on which coordination in different sections will take place, together with the submission of the working drawings. The Engineer shall arrange to return to the Contractor at least one week prior to the commencement of concreting of the section, his comments or approval of the working drawings.**



The Contractor shall supply detailed specifications, dimensional drawings, etc., of equipment that he proposes to supply and install.

Where this Contract requires the approval of Engineer to material and goods, the Contractor must seek to obtain this approval within eight weeks after signing of the Contract. No extension of time will be granted for non-availability of material or goods if this clause is not complied with. Approval of the Engineer does not relieve the Contractor of placing his orders in due time for the materials he needs to complete the Contract on time. The approved samples shall be retained on site for comparison with commodities used in works and removed when no longer required.

#### 14.0 MATERIAL ORIGIN AND QUALITY

The material and equipment shall be purchased from Consultant / Owner's agreed suppliers.

The consultant / owner shall retain the right to at any time demand the indication of origin of the materials, and to eventually refuse products, the origin of manufacturing of which have not been previously agreed to without consideration of quality.

On specific agreement of the Owner, the materials may be delivered progressively to the field, but in such a manner as to allow sufficient time for their reception.

When choice of manufacturer is allowed for any particular commodity the Contractor shall obtain the whole quality required to complete the work from one manufacturer or obtain approval of any change in source of supply. He shall produce written evidence of sources of supply when requested to do so by the Engineer.

#### 15.0 IDENTIFICATION OF EQUIPMENT

For each piece of equipment, identification label shall be fitted in front of the casing. The label shall have block letter 7mm high, black on white background of trifoliate and fixed with screws.

#### 16.0 MARKINGS

The contractor shall provide "Danger Boards" and "Shock Charts" wherever required to comply with the requirements of local Electricity Rules and according to normal practice.

#### 17.0 FACTORY TESTS

All equipment supplied by and installed as part of the Contract such as distribution boards and like shall be fully tested at the manufacturers works to the requirements of appropriate standards called for later in the particular specification.

The Contractor shall inform the Engineer in writing about the date and time of test of each equipment at least two weeks in advance. The witnessing of test by the Owner or his representative shall not absolve the Contractor from his responsibility for the proper functioning of the equipment and for furnishing the guarantees referred to in Clause 6.0. All test results in the form of certificate of test / test record certificates, signed by all the witnesses, for



each item in the scope of Contractor's supply shall be supplied to the Engineer within seven days of the test date, and in any event before delivery to the site.

All expenses for carrying out the tests and witness by the Owner or his representative shall be borne by the Contractor and deemed to have been included in the tender bid.

#### 18.0 STORAGE

The Contractor shall store the equipment in such conditions that it can not be damaged, i.e., in a dry warehouse. As particular concerns; fragile components, these shall be stored on shelves in their original packing, fitted with identification labels so as to avoid unnecessary manipulation or handling.

The Contractor shall handle, store and fix each commodity in accordance with the manufacturer's recommendations. He shall inform the Engineer if these conflicts with any other specified requirement and submit copies of manufacturer's recommendations to the Engineer when requested to do so.

#### 19.0 LABOR AND STAFF OF CONTRACTOR

The Contractor shall provide / furnish and arrange for:

- Skilled and unskilled labor required for performing the works in accordance with the technical specifications and drawings within the agreed time schedule.
- Supervisory technical staff with appropriate experience and requisite expertise to ensure quality of work performed.
- Supervisory administration and clerical staff to ensure smooth functioning of the activities at site.
- Construction equipment, meggers, tools, etc.

The Contractor shall supply all labor, materials and equipment necessary for the installation of low voltage distribution boards, cables, lighting and power equipment, together with all other apparatus shown on the drawings and as detailed in the Particular specification.

#### 20.0 SMALL INSTALLATION MATERIAL

The Contractor shall supply all small installation and consumable materials such as nuts, bolts, washers, shims, angles, leveling materials, insulation tape, solder, PVC strap-on or heat shrinkable type cable tags, cable ties, bushes, sealing compound, Avometer, electrical testing and measuring instruments, etc., and all such other material not listed in BOQ, required for complete installation as intended by the specification and scope of works.

#### 21.0 INSTALLATION INSTRUCTIONS - GENERAL

The Contractor shall set out the works himself as per specifications and drawings and shall properly position the equipment on specified foundation / location. In general, the manufacturer's instructions for installation shall be followed. Any defect or faulty operation of equipment due to Contractor not following the manufacturer's instructions shall be corrected and repaired by the Contractor at his own cost.



## 22.0 ASSOCIATED CIVIL WORKS

The expression 'Associated Civil Works' shall mean civil work to be carried out by the Contractor under the direction of the Engineer in connection with the Electrical Service.

The Contractor shall prepare accurate drawings giving details of all holes, fixings, bases and other civil work requirements and shall be responsible for their accuracy. The cost of preparing shop drawings shall be considered to have been so specified in the tender price.

The following is a summary of the work to be carried out by the Contractor:

- a. The cutting and forming of holes for conduits or pipes, or conduit or pipe fixings through walls, floors, ceilings, partitions, roofs, etc., and making good after the work is sufficiently advanced.
- b. The building of concrete and / or brick ducts in floors, walls, etc.
- c. The formation of concrete bases, etc., for equipment.
- d. Excavation forming for underground services of ducts and courses and then covers it.
- e. The cutting or forming of chases, recesses, etc., in floors, walls, etc., for conduits and fittings in and making good.
- f. Excavation for and laying of cable carrying pipes.
- g. The building in of brackets and supporting bars or other form of conduit or pipe suspensions.
- h. The painting of all pipes, tube and conduits etc. after fixing unless specified to the contrary.
- i. The providing and building in of sieves through slabs and walls.

In general all required holes through walls, floors and beams for pipes and ducts will be left out by the Contractor during the process of building.

Where conduits, pipes or fittings are fixed to concrete or woodwork by means of saddles or clips, the Contractor shall himself execute the work necessary and the cost of such work shall be considered to have been so specified in the price.

Cutting, fitting, repairing, patching or plastering and finishing of carpentry work shall be done by craftsmen skilled in their respective trades, when cutting is required it shall be done in such a manner as not to weaken structure, partitions or floors. The holes required to be cut must be directed without breaking out around the holes. Where patching is necessary in finished areas of building, the Engineer shall determine the extent of such patching or refinishing.

## 23.0 TESTING – GENERAL

Upon completion of installation, at least seven days notice is to be given of intention to perform any test. The Contractor shall perform all static, semi-dynamic (by simulation), and dynamic field testing on all the equipment and systems.



All tests shall be conducted in the presence of the Engineer for the purpose of demonstrating equipment or system compliance with specifications. The Contractor shall submit for Engineer's approval complete details of tests to be performed describing the test procedure, test observations and expected results.

The Contractor shall furnish all tools, instruments, test equipment, materials, etc., and all qualified personnel required for the testing, setting and adjustment of all electrical equipment and material including putting the same into operation.

All tests shall be made with proper regard for the protection of the personnel and equipment and the Contractor shall be responsible for adequate protection of all personnel and equipment during such tests. The cost of any damages or rectification work due to any accident during the tests shall be the sole responsibility of Contractor.

The Contractor shall record all test values of the tests made by him on all equipment. Four copies of all test data and results certified by the Engineer shall be given to the Engineer for record purposes. These shall also include details of testing method, testing equipment, diagrams, etc.

The witnessing of any tests by the Engineer does not relieve the Contractor of his guarantees for materials, equipment and workmanship, or of any obligations of Contract.

In addition to installation testing, the Contractor is to carry out operation testing of all sections and is to clean, set, calibrate and fully commission, demonstrate and hand over to the Owner the entire Contract works in a thoroughly complete and operational state to the satisfaction of the Engineer.

The acceptance - provisional or final - shall be made by the Owner. This reserves him the right to be represented or assisted by a representative or an organization (whether official or not) of his choice, which may decide on his behalf any repairs deemed necessary resulting from lack of observations of this specification, or of the rules and standards. In addition, he may judge the quality of the works and the materials supplied.

This remains in force in case of sub-contracting.

The Contractor shall formally engage his direct responsibilities to the Owner or his representative, and likewise, shall assume all responsibility for work performed by sub-contractors and materials he has supplied and installed.

### **23.1 Insulation Resistance Test**

Insulation resistance test shall be made on electrical equipment by using a megger of 1000 volts for circuits between 250 and 500 volts. The insulation resistance of distribution boards, cables, etc., shall be as per IEC, IEEE, BSS and Pakistan Electricity Rules.





The distribution boards shall be given an insulation resistance measurement test after installation, but before any wiring is connected. Insulation tests shall be made between open contacts of circuit breakers, switches and between each phase and earth.

If the insulation resistance of the circuit under test is less than specified value, the cause of the low reading shall be determined and removed. Corrective measures shall include dry-out procedure by means of heaters, if equipment is found to contain moisture. Where corrective measures are carried out, the insulation resistance readings shall be taken after the correction has been made and repeated twice at 12 hours interval. The maximum range for each reading in the three successive tests shall not exceed 20% of the average value. After all tests have been made, the equipment shall be reconnected as required.

### 23.2 Earth Resistance Test

Earth resistance tests shall be made by contractor on the earthing system, separating and reconnecting each earth connection as may be required by the Engineer. If it is indicated that soil treatment or other corrective measures are required to lower the ground resistance values, the Engineer will determine the extent of such corrective measures.

The electrical resistance of the E.C.C. together with the resistance of the earthing lead measured from the connection with earth electrode to any other position in the completed installation shall not exceed one ohm.

Earth resistance test shall be performed as per Electrical Inspector's requirements. Where more than one earthing sets are installed, the earth resistance test between two sets shall be measured by means of Resistance Bridge Instrument. The earth resistance between two sets shall not exceed one ohm.

### 23.3 Switchgear

Each circuit breaker shall be operated electrically and mechanically. All interlocks and control circuits shall be checked for proper connections in accordance with the wiring diagrams given by the manufacturer.

The Contractor shall properly identify the phases of all switchgear and cables for connections to give proper phase sequence.

Trip circuits shall be checked for correct operation and rating of equipment served. The correct size and function of fuses, disconnect switches, number of interlocks, indicating lights and alarms shall be in accordance with approved manufacturer drawings. Nameplates shall be checked for proper designation of equipment served. Protective relays shall be tested and set at site prior to commissioning of the equipment.

#### 23.4 Special Systems Tests

The special systems such as telephones, intercom, etc., shall be tested according to the procedures laid down in the respective sections of the technical specifications. However, any specific tests recommended by the manufacturer shall also be carried out as approved by the Engineer.

#### 23.5 Complete Tests

After any equipment has been tested, checked for operation, etc., and is accepted by the Engineer, the Contractor shall be responsible for the proper protection of that equipment so that subsequent testing of other equipment do not cause any damage to the already tested equipment.

#### 24.0 ELECTRICAL CONNECTION

Electrical connection for each building shall be supplied by other but necessary arrangement coordination to be done by this Contractor.

#### 25.0 SHOP DRAWINGS/ AS BUILT DRAWINGS AND SERVICE MANUALS

A record shall be kept both in hard and soft copies as the work proceeds of any work not in accordance with the working drawings, and upon completion of the work, the Contractor shall prepare the following drawings and forward them to the Engineer for approval:

- a. Duplicate prints of as built single line diagram of the main and sub main distribution network, indicating all cables, their size and type, and the rating of all protection devices such as circuit breakers, fuses, etc.
- b. Duplicate prints of asbuilt/shop drawings of Lighting, Power, Telephone, Data, Fire Alarm, Public Address, CCTV, Access Control, and Queue Management systems as applicable.
- c. Duplicate prints of as fixed control and wiring diagrams for the equipment installed as part of the Electrical Contractor works.

After these drawings have been approved, the Contractor shall supply two prints on paper of each and insert these in the operating and maintenance manual specified below.

The Contractor shall submit to Engineer for approval a sample of manufacturer instructions for installation, testing, commissioning, operation and maintenance manuals including manuals of spare parts and tools of the equipment. Upon acceptance, the Contractor shall supply three copies to the Engineer for forwarding to the Owner. These manuals should be in properly bound form. At least two copies of the documents shall be submitted in original. The installation instruction shall be submitted two weeks prior to commencement of installation of each equipment, and operation and maintenance instruction at the time of commissioning. If the Contractor fails to provide the documents, the Engineer shall withhold issuance of requisite certificates and deduct suitable amount from the payments to the Contractor.



## 26.0 WORK COMPLETION

The Contractor shall further make good, repair, replace all defective works and clear away on completion and leave all installations in perfect working order and to the satisfaction of the Owner or his representative.

## 27.0 PAYMENT

No separate payment shall be made for work involved within the scope of this section unless specifically stated in the Bill of Quantities or herein.



## SECTION - E - 2 LOW VOLTAGE SWITCHBOARDS / DISTRIBUTION BOARDS

### 1.0 GENERAL

#### 1.1 Purpose

This section together with its appending document covers the minimum requirement for the design, construction and performance of factory built assemblies of LV switchboard.

#### 1.2 Scope of Work

The work under this scope consists of supplying, installation, testing, connecting and commissioning of all material and services of the complete switchboard as specified herein and/ or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

#### 1.3 Standards

Switchboards shall comply with Section - E - 1, Clause 3.

Particular reference shall be made to:

IEC 60027	Letter symbols to be used in Electrical technology.
IEC 60051	Direct setting electrical measuring instruments.
IEC 60073	Colour for indicator lights and push bottoms.
IEC 60158	LV Switch gear and control gear.
IEC 60185	Current Transformers.
IEC 60186	Voltage Transformers.
IEC 60269	LV fuses.
IEC 60439	Factory built assemblies of LV switch gear and control gear.
IEC 60529	Degree of protection provided by enclosures.
IEC 60617	Graphic symbols for diagrams.
IEC 60947-2	LV Switch gear and Control gear.
BS 951	Earthing Clamps.
BS 1433	Hard drawn bare copper conductor for earthing.
BS 2874	Nuts, Bolts, Washers and Rivets for use on copper.
BS 6346	PVC Insulated Cables.
CP 1013	Earthing.

Any other standard referred to in above standards or these specifications.

#### 1.4 Installation and Service Conditions

For general site conditions refer to Section - E - 1, Clause 4.

Switchboard shall be installed indoor. The equipment shall be capable of operation under the prevailing ambient conditions without any deleterious effect of any kind. Switchboard shall be suitable for continuous operation at full load rating under combined variation of both voltage and frequency as stated in Section - E-1, Clause 5.1.

Transient voltage depression down to 80% of rated voltage shall not affect the performance of the equipment and dip voltage must be within permissible limit.

## 2.0 MAIN ELECTRICAL CHARACTERISTICS

### 2.1 Power Supply System

Main characteristics of power supply system applicable to all switchboards are:

- Voltage 400 V  $\pm$  10%
- Phase 3  $\phi$ , 4 Wire.
- Frequency 50 Hz,  $\pm$  2 Hz.
- Neutral system Solidly grounded.
- Peak asymmetrical SCC To be specified by the bidders.
- RMS symmetrical SCC To be specified by the bidders.

Main characteristics of auxiliary supply system are:

- Control / Command system 24 VDC.
- Space heater system 230 VAC.

### 2.2 Ratings

The equipment shall be capable of carrying the specified current on a continuous basis of 24 hours / day, without exceeding the permitted temperature.

The current ratings of all equipment must be guaranteed at the specified design temperature. Equipment shall be fully rated and constructed for withstanding, making and breaking the specified short circuit duty.

Pins of auxiliary circuits shall be sized for a rated circuit of 10 Amp. Minimum.

## 3.0 GENERAL REQUIREMENTS

### 3.1 Concept

The Switchboard shall be of standard, prefabricated metal clad cubicle(s), floor mounting type, totally enclosed, dead front, dust tight and vermin proof requiring front access only. It shall complete in all respects with material and accessories, factory assembled, tested and finished all according to the specifications and to normal requirements. For indoor installations the international classification shall be IP42.

The Switchboard with all components and accessories shall be suitable for front operation only and shall:

- have a rated service short service breaking capacity, Ics at 400 VAC, conforming to IEC 60947-2 unless otherwise stated on the drawings.
- be provided with adequate clearance from live parts so that flash over cannot be caused by switching, vermin, pests, etc.
- have all components rated for insulation class 600-volt minimum.



- be designed for flush mounting of all instruments on the front side.
- have all incoming or outgoing connections from the top or bottom as required. Have the components mounted so as to facilitate ease of maintenance from the front. Have common lamp test facility for all lamps.
- have wiring diagram on the inside of door of the switchboard. Be labeled with nameplate on the front side of door.
- have arrangements for extension of switchboard in future.

### 3.2 Accessibility

Switchboard shall preferably be arranged for battam cable entries. Adequate space must be provided for cable entries and termination. It shall be possible to work easily and safely on cable of a main or control outgoing circuit in OFF position with the remainder of the board alive.

Adequate system shall be provided for installation and clamping of cables inside the cable compartment. Position of terminals and cables shall allow use of clamp ammeter.

Power and Control cable termination shall avoid obstruction to other cable termination and provide easy access for terminating cables. Cable supports shall be provided to avoid undue strain on cable termination. Easily accessible locations shall be reserved in the compartment for measuring transformers.

### 3.3 Heaters

Space heaters shall be provided for prevention of moisture in each cubicle. Heaters shall be wired together and shall be automatically controlled to avoid over heating the equipment. Heater shall be suitable for operation on 230 VAC supply from an external source (to be provide in main Distribution Board)

### 3.4 Name plates

On the front side, a name plate shall be provided at the top to indicate the name of manufacturer, system voltage and frequency and the current carrying capacity of switchboard.

Each breaker shall have a circuit identification label fitted below the breaker aperture or as suitable.

Drawing indicating the branch circuit names, breaker elements, cable sizes and connecting services shall be placed in a clear plastic pocket provided at the back of the front access.

Labels described shall have block letters 7 mm high on a white background, to be made from traffolite and be fixed with screws.

Each incoming and outgoing circuit shall also be labeled with name plate 75 mm x 15 mm, as described above on the front side of door.



## 4.0 MECHANICAL DESIGN

### 4.1 General Construction

The switchboard shall be fabricated, welded, grinded, finished with angle iron framework and claddeed with 1.4 SWG MS sheet, to form a rigid, free standing, flush mounting fronted assembly.

It shall be suitably divided into panels and compartments for accommodating the required number of circuit components, instruments and accessories. Each compartment shall be fully partitioned from its neighbor both horizontally and vertically, allowing safe cable routing / termination without shutting the switchboard down.

All live parts within cabinets, compartments or modules, which have to be accessible during normal maintenance operations, shall be adequately protected and / or barred to ensure protection of works and to avoid accidental contact. Barriers may be rigid, transparent, insulating material fitted with warning labels.

The doors shall be provided with hinges on the left-hand side and locking handles on the right hand side for fastening the door. The front assembly shall be fastened to the enclosure by means of self locating fasteners for quick and easy fixing.

All holes, cutouts shall be tool or jib manufactured and free from burrs and rough edges. All structural components shall be of standardized design to provide complete uniformity and inter change ability of common parts. Removable gland plates shall be provided at top and / or bottom as required.

The switchboard shall be supplied complete with foundation bolts and other installation materials as recommended by the manufacturer. Proper size cable clamping channels with galvanized steel clamps and brass cable clamps respectively for unarmoured and armoured cables shall be provided.

The cabling inside the Switchboard shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.

All metal work of the switchboard shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of colour RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.



#### 4.2 Bus Bars

Bus bars and droppers supported on non-hygroscopic material are to be high conductivity electrolytic tinned copper, completely isolated and mechanically braced and rated to withstand the specified short circuit currents for one second duration.

Bus bars and droppers shall be housed in a separate compartment and shall be clearly marked with their respective colors. Bus bars shall be provided for three phases, neutral and multi-terminal earth. The temperature rise shall not exceed 50 degree centigrade at rated current. Neutral bus assembly shall consist of outgoing screw terminals with one terminal for every MCCB / MCB.

Neutral Bus bar should be of same ampere rating as phase bar.

Removable metal covers on the bus bar chamber shall be provided with suitably sized labels at regular intervals, fixed with self tapping screws and warning of live metal work.

All bus connectors shall be tinned plated connections and joints. Horizontal bus bars shall have the same current rating throughout their length.

#### 4.3 Earthing

A copper earth bar of suitable section for the specified fault level shall extend the entire length of the Switchboard. Provisions shall be made for possible future extensions at both ends.

Earthing facilities shall be provided on each incoming and outgoing unit to permit earthing of the connections.

All metallic non-current carrying parts of the Switchboard shall be bonded together and connected to the Switchboard's earth bar.

Each circuit wiring shall be green / yellow colour. Earthing mass continuity between withdrawable parts and fixed frame shall be correctly ensured whatever the withdrawable part position.

Provision shall be made adjacent to cable termination for earthing cable armour to the earth bus bar.

Earthing switch shall be provided wherever mandatory as per rules and regulations / codes and standards and shall be manually operated. An interlocking system shall provide the following locking and safety functions:

- impossibility of closing the earth switch if the switching device is closed.
- Visual check of earthing switch positions to be possible.
- Possibility of locking the earthing switch operating handle in open and closed position.
- The earthing of the bus bar shall be done manually by the operator without provision of general earthing system.



## 5.0 DISTRIBUTION BOARDS

The enclosure of the LV Distribution Board shall be fabricated from electro-galvanized / zinc coated sheet steel.

The LV Distribution Board shall be fabricated with 16 SWG sheet steel recess mounting. All components shall be installed on a common component mounting plate made of 14 SWG sheet steel inside the enclosure and protected from the front with screwed sheet steel front plate. The door and dead front covers shall be made of 14 SWG sheet steel. The door shall be fully gasket with hinges on the left hand side and locking handle on the right hand side for fastening the door. The locking handle should be detachable. The dead / front assembly shall be fastened to the enclosure by means of self-locating fasteners for quick and easy fixing.

The distribution board shall be supplied complete with all installation materials as recommended by the manufacturer. The incoming and outgoing cable connections shall be according to the wiring requirements. If required, an adapter box for accommodating the cables and conduits may be provided. The box shall be of the same material and finish as the Distribution Boards.

An earth bar or terminal strips shall be provided for connection of incoming and outgoing earth conductors. The earth bar or terminals shall be permanently connected to the body of Distribution Boards at two points. Flexible copper strip shall be provided for earthing of the door of Distribution Board.

Neutral bus assembly shall consist of out going screw terminals with one terminal for each MCB. All holes, cutouts, etc., shall be tool or jib manufactured and free from burrs and rough edges. Removable gland plates shall be provided at both the top and / or bottom, as required.

The cabling inside the distribution board shall be suitably numbered and harnessed by means of straps or cords. Wiring to door mounted components shall be in flexible PVC conduit. All indicating, control and selecting equipment shall be suitably arranged and clearly labeled with indelible labels indicating the rating of fuses, switches, etc.

All metal work of the distribution board shall be cleaned down to bare shining metal, phosphate and the surfaces chemically prepared for powder coating. Then these shall be coated with powder of colour RAL 7032 and then baked in oven. The thickness of powder coating shall not be less than 120 microns.

## 6.0 COMPONENTS

The switchboards shall be provided with all components as specified or shown on the Drawings and as necessary for the satisfactory operation of the Switchboard and of the electrical system. All components should comply with EC 60947-2. Typical specifications are given hereunder:

### 6.1 Air Circuit Breaker (ACB)

Air circuit breaker should be draw out type with three poles / four poles as mentioned in drawing suitable for making and breaking a fault condition. Operating mechanism shall be manually or motor operated charged spring with front drive grip handle. These shall be locally operative. Mechanically operative ON-OFF-OFF indicators positively driven in both directions shall be provided to indicate the position of the unit.

Overload and over current features / relays shall be of an adjustable, manually resettable type, according to manufacturer's standard range.

Each ACB shall have built in tester with the selection of Trip or Non-Trip Functions. Also with the facility of testing the ACB in field from single phase (220VAC) supply only. Each of the above function shall have separate LED indicators and Alarm switches for trip monitoring of Overload, Short circuit, Pre trip alarm and Ground Fault. ACB shall be having Trip Memory.

The Breaking Capacity of ACB shall be 65KA. ACB breaking capacity shall be:  $I_{cu}=I_{cs}=I_{aw}$ .

The circuit breaker shall have two normally open and two normally closed auxiliary contacts rated for 10 Amps, 230 VAC. The circuit breaker shall also provide for ON-TRIP-OFF indicating lamps. The circuit breaker shall have specified rupturing capacity without the use of back-up fuses. Auxiliary release and trip coils shall be provided for desired operation and / or interlocking as shown and / or stated on the Drawings.

### 6.2 Moulded Case Circuit Breaker

These shall be three pole 400 / 500 volts rating shown on the drawings. The breakers shall have both time delay over current and instantaneous short circuit protection.

The MCCBs shall be installed such that their switching levers are accessible through the dead front plate for operation. Circuit numbers / designation on all circuits shall be conspicuously marked to facilitate connection and maintenance.

The breaker shall have quick make - quick break toggle mechanism with positive 'ON', 'OFF' and intermediate 'Tripped' positions.

~~Trip mechanism shall be trip free on overload or short circuit ensuring~~  
that the breaker will not close / remain close even if the close command is given while the circuit breaker has tripped due to short circuit or continuing overload.

### 6.3 Miniature Circuit Breaker (MCB)

The MCBs with current rating from 3 to 80 amperes shall be conforming to BS EN 60-898 or IEC 60947-2. The circuit breakers shall be suitable for DIN-rail mounting, maintenance-free and fully tropicalized.

The MCBs shall be designed for horizontal or vertical mounting, or reverse feeding, without any adverse effect on electrical performance.

The operating mechanism shall be quick make, quick break type, trip free, with all poles opening and closing simultaneously (except for the neutral pole, which if required shall be of the advance-closing and late-opening type). The operating toggle shall clearly indicate the ON and OFF/TRIP positions.

The individual operating mechanism of each pole of a multiple MCB shall be directly linked within the MCB casing and not by the operating handle.

Each pole of the MCBs shall be provided with bimetallic thermal element for overload protection and a magnetic element for short circuit protection.

### 6.4 Earth Leakage Circuit Breakers (ELCB)

ELCBs shall be four pole, current operated type with tripping current of 0.3A and tripping time not more than 0.1 seconds.

### 6.5 Load Break Switches

Load Break Switches and contractors shall be of AC3 type for motor loads. Air circuit breakers above 630A shall be housed in separate cubicles. Aluminium plate shall be provided for cable entry to ACBs / MCCBs cubicles of 630A and above rating.

### 6.6 Air Break Contractor (ABC)

The contractors shall be air break, triple pole, 400 / 500 VAC and suitable for the type of duty to be performed. The main contacts shall be silver tipped, butt type with double break per pole. Each contractor shall be provided with single phase 230 VAC operating coil and minimum one spare normally open and one normally closed auxiliary contact. The number of working auxiliary contacts shall be provided according to the system requirements.

## 7.0 POWER FACTOR IMPROVEMENT PLANT

The power factor improvement plant shall be used for improving the power factor at the system. The plant shall be automatic-cum-manual.

The power factor improvement plant shall be aligned with main LT switch board and it shall be a part of that LT switchboard as shown on the drawing. The capacitors shall be suitable for three phases, 415 volts 50 Hz system and shall be self cooled, designed for indoor use in tropical climate for maximum ambient temperature of 45 degrees centigrade and relative humidity 90%.



The capacitors shall be in the form of banks divided for 12 stages, 6 stages and 4 stages. Each capacitor bank unit shall be 25 and 50 KVAR. The total KVAR capacity shall be as indicated on the drawings. Each capacitor unit shall be complete with discharge resistors and internal fuses and shall be connected with control panel with proper size of single core PVC insulated cables.

The panels shall be supplied complete with a set of 3-phase, full capacity, isolated finned copper bus bars, interconnections, risers, designation labels, cable sockets, holding down bolts, wiring with cleats and ferrules, earthing sockets and studs, etc. Each control panel shall comprise:

- 1 No. Multi stage power factor correction relay for automatic/manual control.
- 1 No. 3-phase, 4 wire, 415 volts, unbalanced load power factor indicator.
- 1 No. Auto-off-Manual selector switch.
- 1 No. Current transformer with 5 amps secondary current, having suitable output burden and accuracy.
- 3 Nos. Instrument protection fuses.

#### 7.1 Requirement of Capacitor Banks

According to IEC-831-1 and 831-2.

Fully insulated, terminals to be shielded by a cover.

Dielectric: Plastic poly-propylene, impregnated.

Electrodes: Aluminium coating vacuum metalized.

Safety features: Self healing, Over pressure tear-off fuse.

Withstand switching operations safely.

Maximum inrush current 200 times rated current.

Loading capacity: 1.1 times rated voltage, 1.3 times rated current at delta max.

Overloading capacity 1.5 times rated output at delta max.

Acceptable tolerances - 5/+ 10% of rated output at rated frequency.

Static life expectancy > 100,000 operating hours.

Test Specifications: Terminal versus terminal with an AC voltage 2.15 times rated voltage for 10 seconds duration. Terminals to casing with an AC voltage of 3 KV for 10 seconds duration.

### 8.0 PARTICULAR COMPONENT REQUIREMENTS

#### 8.1 Current Transformers

Current transformers shall comply with the requirements of IEC 60185 (or equivalent).

Current Transformers shall be polyester resin insulated, ring type, air cooled having transformation ratio as indicated on the drawings. The current Transformers shall be of suitable burden having accuracy class 1.0. The Current transformers shall have rated secondary current 5A / 1A as required.

Current Transformers shall mechanically and thermally withstand the specified short circuit capacity. Test terminal blocks shall be provided

for current Transformer secondary circuits having short circuiting provisions to allow portable apparatus to be connected.

## 8.2 Voltage Transformers

Voltage transformers shall comply with the requirements of IEC 60186 (or equivalent) and shall be of the same accuracy class as Current Transformers.

Voltage Transformers shall be equipped with primary fuses with an interrupting capacity of the incoming circuit breakers. Test terminal block shall be provided for each Voltage Transformer system.

## 8.3 Ammeters and Voltmeters

Indicating instruments shall be semi-flush Switchboard type, moving iron, spring controlled with standard scale having white background and black graduations and markings. The front dimensions shall be 144 x 144 mm for instruments on incoming side and 96 x 96 mm on a outgoing circuits.

Indicating instruments shall be 1.0 class percent of full scale basic accuracy class in accordance with IEC 60051.

The ammeter shall be suitable for connection to 5 Amp. Secondary of Current Transformer or directly through shunt as shown on the drawings. The instruments shall have measuring range indicated on the drawings. A red mark shall be provided at the working voltage on the scale of all voltmeters.

## 8.4 Selector Switches

Ammeter and voltmeter selector switches shall be complete with front plate, grip handle, R-Y-B and OFF position for ammeter and RY-YB-BR-RN and OFF positions for voltmeters.

The selector switches for controls shall be rotary cam type and shall be provided complete with knob and front plate, showing all positions as required.

## 8.5 Push Buttons

The push buttons shall be momentary make / break contact type (normally open / normally close) and suitable for flush mounting. The push button for ON and OFF switching shall be red and green respectively.

## 8.6 HRC Fuses

HRC Fuses shall be provided complete with fuse bases, fuses, etc. The fuses shall have a fusing factor as specified for class Q in accordance with BS 88.

## 8.7 Pilot Lamps

Switchboard shall be provided with phase indicating pilot lamps. The lamps shall be rated for 250 volts supply and suitable for flush mounting. The front of the lamps shall have colored rosettes for identification of

phases.

#### 8.8 Line up Terminals

Line up terminals wherever provided for Control or Power circuits shall be suitable for voltage and size of conductors as indicated on drawings. The Line up terminals for controls shall be suitable for channel mounting. All necessary accessories such as end-plates, fixing clips, transparent label holder caps and label sheets with marking shall be provided.

#### 8.9 Secondary Wiring

All wiring shall be copper conductor, thermoplastic insulated, at least 1.5 sq. mm flexible, neatly arranged and clipped in groups.

Each conductor and its termination are to be identified and marked with numbered ferrules. All live terminals are to be shrouded.

Secondary wiring for Current Transformers shall be carried out with not less than 2.5 sq. mm. Terminals shall be specially marked to avoid opening of the circuit by accident.

#### 9.0 INSTALLATION

The LV Switchboard shall be installed at location shown on the drawing. The Contractor shall ensure coordination with civil works for providing any openings, holes, etc. to avoid any breakage to completed works. In case the provisions in civil works for the installation of electrical equipment are not made or made incorrect the same shall be rectified by the Contractor at his own cost and to the satisfaction of the Engineer. The Contractor shall provide foundation bolts and grout them in cement concrete floor using non-shrinkable material with the approval of Engineer.

All installation material for physically erecting the Switchboard, such as bolts, nuts, washers, supporting steel, etc., shall be provided and installed by the Contractor. The Switchboard shall be installed upright and in level and shall be firmly and rigidly bolted to the floor and concrete supports.

The switchboard shall be completely erected as per manufacturer's instructions and as approved by the Engineer. Loose parts dispatched by the manufacturer shall be installed and connected as per assembly drawing provided by the manufacturer. Any safety locking provided by the manufacturer for safe transportation shall be released only after the switchboard is erected in position.

The incoming and outgoing cables shall be connected as recommended by cable manufacturer. The cable armour shall be connected effectively to ground.

The Switchboard body shall be connected to earth as per instructions given in section "Earthing" of these specifications. The Switchboard shall be tested and commissioned in the presence of the Engineer. The tests to be carried out shall be tested before energizing as per instructions contained in the article "Testing" of General Specifications of Electrical Works, section B.1 of these specifications.



## SECTION - E - 3 LOW VOLTAGE CABLES AND WIRES

### 1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation, testing, connecting and commissioning of all material and services of low voltage cables and wires and the accessories as specified herein or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The LV cables and wires with accessories shall also comply with the General Specifications for Electrical Works, Section E-1 and with other relevant provisions of the Tender document.

### 2.0 GENERAL

All multicore and single core wires for light circuits, socket outlets and circuits operating up to 250 volts shall be 300 / 500 volts grade. All single core sheathed cables shall be of 450 / 750 volt grade and up to 50sqmm and above shall be of 600/1000V. Power cables for main feeders, main to sub main feeders, power equipment, etc., armoured or unarmoured shall be of 600 / 1000 volts grade.

Armouring of cables shall be done with appropriate size galvanized steel wire as per codes.

The conductors shall be stranded or solid, high conductivity, soft annealed copper. Conductor of single core cables shall be circular, whereas of multicore cables may be circular or shaped according to standard practices and codes. The PVC insulation shall be extruded with a PVC compound having good flexibility, resistance to aging and ability to withstand the ambient temperatures as given in General Specifications for Electrical Works, Section E-1 of these specifications. Cable should be capable of running 125% of full load current without any damage.

### 3.0 STANDARDS

LV Cables and Wires shall comply with Section - E-1, Clause 3.

Particular reference shall be made to:

BS 6004 / 6346	PVC insulated cables for lighting and power.
BS 6746	PVC insulation for electrical cables.
BS 6360	Copper conductors
BS 6500	Insulated flexible cords.

Any other standard referred to in above standards or these specifications.



#### 4.0 MATERIAL

##### 4.1 General

The power, lighting and control cables shall be furnished and installed in accordance with the routes and requirements shown on the drawings.

All cables shall have phase identification colours on insulation of each core. The colour code for three phase circuits shall be red, yellow and blue for phase conductors and black for neutral conductor. Where insulated earth conductor is installed, it shall have green colour insulation.

Single phase circuits shall have insulation of red colour for phase / line, black colour for neutral and green colour for earth conductor.

All DC circuits shall have insulation of red colour for positive, black colour for negative and green for earth conductor.

The ends of each length of multicore armoured or unarmoured cables shall be properly marked for clock-wise and anti clock-wise sequence of core colors.

##### 4.2 Cables for Conduit Wiring

All cables / wiring in concealed or surface mounted PVC or steel conduits shall be single core PVC insulated of specified grade and size, unless specifically shown on the drawings or given in BOQ.

##### 4.3 Cables on Surface / Concrete Trenches

Cables for distribution system to be installed on surface, in cable ducts, in concrete trenches or on trays shall be single or multicore PVC insulated and PVC sheathed of specified voltage grade and size, unless specifically shown on the drawings or given in BOQ.

##### 4.4 Underground Installation

Cables for laying directly underground shall be PVC insulated, PVC sheathed and armoured with galvanized steel wire. Cables fully installed in underground ducts / pipes and mechanically protected from end to end shall be PVC insulated and PVC sheathed unless specifically shown on the drawings or given in BOQ.

##### 4.5 Cable Accessories

All cable accessories shall be provided for the complete cabling and wiring system without any additional cost unless specifically mentioned in BOQ. These shall include but not limited to the items such as saddies, clamps, fixing channels, connectors, cable joints (where necessary and approved by the Engineer), clips, lugs, tapes, solder, identification tags, bushes, glands, etc.



## 5.0 INSTALLATION

### 5.1 General

When the laying is effectuated by others, the contractor shall test the cable characteristics (insulation and continuity), at all phases of these and communicate them in a report to the Engineer, as per recommendations of the standards according to which the cable is manufactured.

The cables shall be spaced by categories along their entire length as well as upon penetration into buildings and in their interiors, according to their following rated voltages:

- 30 cm at least between a cable carrying 1 KV - 30KV and other cables.
- 20 cm at least between a cable carrying voltages between 50V - 500V, and any power or control 10 cm at least between a cable carrying voltages lower than 50V and telephone or those possible being grouped.

All installation material, labour, tools and accessories for cable installation shall be furnished by the Contractor. The cable and accessories shall be installed as described in accordance with these specifications, drawings and manufacturer's instructions.

### 5.2 Conduit Wiring

The wiring through conduit shall be started only after the conduit system is completely installed and all outlet boxes, junction boxes, etc., are fixed in position. The filling rate inside the conduits shall not exceed 50 %. Cables directly embedded in the masonry are not accepted.

The wires shall be pulled in conduit with care, preferably without the use of any lubricant. Where necessary and if approved by the Engineer, the cable manufacturer's recommended lubricant may be used. Where several wires are to be installed in the same conduit, they shall be pulled together along with the earth conductor. All wires of same circuit shall be run in one conduit.

The wires shall not be bent to a radius less than 10 times the overall diameter of the wire, or more if otherwise recommended by the manufacturer.

The wiring shall be continuous between terminations and looping-in system shall be followed throughout. Any joint in wires shall not be allowed. The use of connectors shall only be allowed at locations where looping-in is rendered difficult. The consent of the Engineer shall be required for using connectors. The connector shall be of suitable rating having porcelain body with sunk-in screw terminals. The connector shall be wrapped with PVC insulation tape after its installation. A minimum of 150 mm extra length of cable / wire shall be provided at each termination to facilitate repairs in future.



### 5.3 Cables on Surface / Trenches

All cables for installation on surface of wall, column, ceiling, trenches, etc., shall be fixed to the surface by means of galvanized steel clips, secured to a steel channel using suitable stud plate, nuts and washers.

The erection of cables and position of support shall be agreed by the Engineer on site, having taken into consideration the accessibility of all such routes. These shall be so arranged that cable crossing one another be minimized if cannot be avoided.

Cables shall be fixed throughout their length by means of approved saddles, clips, etc., at every 600 mm vertically and 900 mm horizontally.

Cables and equipment fixed to a building fabric, i.e., brickwork, concrete, etc., shall be fixed by means of appropriate fixing devices, i.e., Raw bolts, Hilti fixing devices, etc., or alternatively by means of suitable fixing devices cast at site, e.g., concrete inserts.

Contractor shall be responsible for all drilling of steel work, brick work and masonry where necessary for fixing clamps and brackets for supports.

Cables shall not be pulled into conduit until the conduit system has been completed, cleared and free from obstruction and sharp edges.

It shall be ensured that conduit system is clear before cable is drawn in, cables shall be put into conduits in such a manner that there will be no cuts or abrasions in the cable insulation, protective braid and jackets. There shall be no kink in the conductors.

Distance of saddles shall be used for installation of cables in defined condition of the surface of wall etc.

Grease or other injurious lubricants shall not be used in pulling cables. The use of talc or non injurious lubricants is permissible, if desirable.

The number of wires installed in any conduit shall be such that the resulting space factor does not exceed 50 %. Spliced wires shall not be pulled through conduits.

All conduit wiring shall be carried out in the loop - in principle from outlet box to outlet box and in no circumstances shall joints be used except in fixed base connection blocks housed in outlet boxes.

The vertical clearance between two adjacent cables at any point is 50 mm minimum. Common mounting channels are to be furnished for cable along the same route. The Contractor can offer alternate cable fixing arrangement, which shall be approved by the Engineer before commencement of installation.

The wall crossings where the outdoor cables penetrate in the building shall be carefully obstructed by means of polyurethane foam. The Contractor shall be fully responsible for the perfect tightness of these

cable penetrations.

#### 5.4 Underground Cables

The Contractor shall plan and take special care to prevent any damage to existing underground facilities such as underground piping, cables, foundations, etc. The Contractor shall notify the Engineer of any obstruction encountered and shall provide protective support or removal of such obstructions as instructed by the Engineer. Excavation adjacent to existing facilities, such as foundations, manholes, ducts, underground pipelines and paving shall be braced and / or shored properly to protect those facilities during excavation and construction.

Sufficient slack shall be left in cables for this purpose that cut lengths of cables shall allow about 3% more in the measured lengths between terminations.

Cables, whether installed underground or in concrete trenches, shall not be bent to a radius less than 10 times the diameter of the cable or as recommended by the cable manufacturer, whichever is higher.

All cables shall be marked at least at each end, switch gear and equipment termination, where cable enter or leave underground cable trenches or channels, where cable rises from one level to another, at 30M intervals with predetermined identification numbers, by means of proprietary non-deteriorating type, PVC, heat shrinkable, strap-on type or equivalent, for the identification of cable and circuit. These shall be indelibly marked with cable number and securely fixed to the cable. Where conductors are left to be terminated by another party or left to be connected later, they shall be identified. The earth continuity conductor shall be laid in the trench with the cables.

Cables entering the buildings shall also be laid in protective pipes. The protective pipe ends, after installation of cables, shall be plugged water tight by means of polyurethane foam / bituminized Hessian or equivalent method as approved by the Engineer.

#### 5.5 Cable Termination and Joints

Cables shall be terminated in a safe, neat and approved manner at the associated equipment, included that erected by others.

Compression type connectors (jugs) shall be of the correct size and approved type for the conductors concerned. Compression tools shall be supplied for specific use and shall be maintained in good order. After compression the conductor and terminal shall form a solid mass ensuring good conducting properties and mechanical strength. The compression jointing system used throughout the installation must be approved by the Owner or his representative before use.

The Contractor shall be responsible for all drilling and if necessary, tapping entries where these have not been provided by others.

When preparing cables prior to fitting glands, the gland manufacturer's instructions for cable preparation shall be observed. In all cases where armoured cables are used, care shall be taken to ensure that the lay of the armour is maintained after the gland is completely fitted.

Termination and joints shall be suitably insulated for the voltage of the circuits in which they are used.  
Every compression joint shall be of a type, which has been the subject of a test certificate as described in BS 4579.

Cable ends, which are not terminated immediately after cutting, shall be sealed effectively to prevent ingress of moisture and shall be protected from damage until termination.

For all cables above 6 sq. mm in section, if a substantial mechanical clamp is not provided a compression type lug or socket shall be provided. At all equipment, cable shall be installed and terminated so that no strain is imposed on the cable or gland and due allowance made to counter the effect of vibration. At all termination an ample length of 'tail' shall be left.

Where joints in cable conductors and bare conductors are required, they shall be mechanically and electrically sound and they shall be accessible for inspection. Joints in non-flexible cables shall be made either by soldering or by means of mechanical clamps or compression type socket, which shall securely retain all the wires of the conductors.

Any joint in flexible cable shall be effected by means of cable coupler. Cable couplers and connectors shall be mechanically and electrically sound and shrouded in metal, which can be earthed. Where the apparatus to be connected require earthing every cable coupler shall have adequate provision for maintaining earth continuity.

Cables of AC circuits, installed in PVC or steel conduit shall always be so bunched that the cables of all phases and the neutral conductor (if any) are contained in the same circuit. The outdoor apparatus shall normally be connected by means of cables with conduit termination down to about 30 cm below ground level or concrete foundation. The conduit shall be firmly secured down to their penetration into the trench or channel.



## SECTION - E - 4 CONDUITS AND PIPES

### 1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete Conduits and Pipes as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The Conduit and Pipes with accessories shall also comply with the General Specifications for Electrical Works, Section E-1 and with other relevant provisions of the Tender document.

### 2.0 GENERAL

The extent of works shown on the drawing does not indicate the exact position of conduit and pipes. The Contractor shall ensure exact location and route of conduit and pipes in coordination with other services drawings, as per site requirements and as directed by the Engineer.

The quality and material for the accessories of conduits and pipes such as sockets, elbows, bushings, bends, inspection / pull boxes, round boxes, etc., necessary for the completion shall be similar to that of conduit or pipes. All the accessories shall be supplied by the Contractor without any extra cost and deemed to have been included in the price of conduits / pipes.

### 3.0 STANDARDS

Pipes and Conduits shall comply with Section - E-1, Clause 3.  
Particular reference shall be made to:

BS 31	Steel Conduit and accessories
BS 1378	Galvanized Iron Pipes and accessories.
BS 3595	PVC Pipes and accessories.
BS 4607	PVC Conduits and accessories.

Any other standard referred to in above standards or these specifications.

### 4.0 MATERIAL

#### 4.1 PVC Conduits, Pipes and Accessories

The PVC conduits and accessories for lighting and power circuits shall be furnished by the Contractor as shown in the drawings or given in BOQ. The PVC bends shall have enlarged ends to receive conduit without any reduction in the internal diameter at joint. Manufactured smooth bends shall be used where conduit changes direction. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of sharp 90 degree bends and tees will not be allowed for concealed wiring.

The round PVC junction boxes for ceiling light or fan points shall have minimum dimensions of 64 mm diameter and 64 mm depth. The junction boxes for wall light points shall have minimum dimensions of 57 mm diameter and 40 mm depth. Round junction boxes shall be provided with one piece bakelite cover plate fixed to the box by means of galvanized screws.

The PVC pipe shall be rigid and shall be minimum D-Class (working pressure - 12 Kg / cm), unless otherwise stated on Drawings or Bill of Quantities. Where pipe changes direction, manufactured smooth bends shall be used. For jointing of pipe, all precautions and procedures recommended by manufacturer shall be followed.

#### 4.2 Steel Conduit and Accessories

All conduits shall be of heavy gauge 16 SWG steel, manufactured and tested in accordance with latest relevant standards.

The conduit shall be protected by two base coats of red oxide anti-rust paint and finished in first quality black enamel paint. The coating shall be of heavy enamel, which shall not flake or crack during installation and handling. Each conduit length shall be furnished with threaded ends and a threaded coupling at one end. Soft metal bushes shall be provided at conduit termination to prevent damage to cable during pulling operation.

Junction boxes shall be 100 mm square, having minimum depths of 38 mm or 65 mm as required for accommodating the number of wires. The junction box shall be 16 SWG sheet steel provided with anti-rust paint and finished in heavy black enamel paint. The cast iron outlet boxes for light points shall be round having 50 mm diameter and 63 mm depth. The above dimensions are given as minimum only, and the exact size shall be determined by the Contractor keeping in view the ease of installation and maintenance. All outlet boxes and junction boxes shall be provided with one piece bakelite cover plate of suitable design.

#### 4.3 Galvanized Iron Pipes and Accessories

The G.I. pipes shall be galvanized from inside and outside by hot dip galvanizing method. The pipes shall be free from stains, burrs or any other defect. The accessories for G.I. pipes shall be galvanized from inside and outside. The conduit shall be NPT threaded, with at least 5 complete threads and assembled with TEFLON tape.

#### 4.4 Inspection Boxes / Pull Boxes

The rectangular inspection boxes or pull boxes shall be of 16 SWG heavy gauge, sheet steel having nipples welded to box at entry points to receive PVC conduit with force fit. The box shall be painted inside and outside with black enamel paint over a base coat of red oxide primer paint. The minimum length of inspection box shall not be less than six times the cable manufacturer's recommended bending radius.

of the cable. All concealed type pull boxes shall have a white plastic sheet of appropriate size fixed to the box by means of galvanized screws.

#### 4.5 Adaptable Boxes

Adaptable boxes shall be made of 16 SWG sheet steel box, painted and finished to the same quality as the light Distribution Board. The boxes shall be 50 mm in depth for conduits up to 25 mm diameter, 63 mm in depth for conduits up to 40 mm diameter and 87 mm in depth for conduits up to 50 mm in diameter. For conduits more than 50 mm in diameter, the minimum depth shall be two times the diameter.

#### 4.6 Conduit / Pipe Accessories

Bushes, plugs, glands, etc., shall be of brass and all male bushes shall be of long thread pattern. Covers for boxes shall be screw fixed and finished as the boxes. Gaskets shall be fitted only when finish is galvanized unless otherwise specified.

#### 4.7 Cable Trunking

Where required, wiring shall be run in hot-dipped galvanized (after fabrication) sheet steel cable trunking of the specified gauge complete with all fittings and accessories, manufactured and installed in accordance with BS 4678/NEMA. The trunking shall be constructed with return flanges. Trunking covers shall be secured by anchored turn-buttons and locking bars and minimum length of individual sections shall be 2.44-m. The trunking shall be suspended/supported from the structure at maximum 2-m intervals with straps and hangers fabricated from minimum 6-mm dia HDG bars, or supported by angle-iron brackets.

Conduit drips from the trunking shall also be supported with hangers. Factory made connectors shall be used at joints.

Junctions (tee and 4-way) in multi compartment trunking shall be double depth to avoid reduction in cabling space. Cable in vertical runs shall be supported by pin racks, prongs or bridging pieces. Fire barriers shall be provided at each floor level. Allowance for expansion shall be incorporated.

Bonding links shall be provided at each joint and secured by screws, nuts and shockproof washers. The bonding links shall make contact with the metal of the trunking or fitting, and continuity shall not depend on contact through the screws, nor on removal on site paint finish from ferrous metal.

### 5.0 INSTALLATION

#### 5.1 PVC Conduits - Concealed

The conduit shall be installed concealed in roof, wall, column, etc. At all joints and bends, PVC jointing solution as manufactured by Pakistan PVC Limited or approved equivalent must be used to

strengthen and to seal the joint.

Manufactured smooth bends shall be used. Bending of conduits by heating or otherwise will be allowed in special situations only, for which the consent of the Engineer shall be required. The use of 90 degree bends and tees will not be allowed.

The conduit shall have a minimum of 38 mm cover of concrete. In the reinforced cement concrete (RCC) work, the conduit shall be laid before pouring of concrete. Under no circumstances shall chases be made in the RCC structure for concealing conduit and accessories, after pouring of concrete. The concrete shall be supported on top of bottom reinforcement of slab and shall be firmly secured by tying to the reinforcing steel in order to avoid being disturbed during pouring of concrete.

All outlet boxes to be firmly supported and installed such that they finish flush with the soffit of slab or beam.

Where conduits have to be concealed in cement concrete (CC) work after concreting, or in block masonry, chases shall be made with appropriate tools and shall not be made deeper than required. The conduit shall then be fixed firmly in the recess and covered with cement concrete mixture to have to at least 32 mm cover before plastering. The work of curing in the cement concrete work or block masonry work shall be coordinated with the civil work. The Contractor shall obtain approval from Engineer for the route, to suit the site conditions before starting chasing and cutting.

The termination of conduits at or near the Switchboard / Distribution Board is shown diagrammatically on the drawing. The exact final locations of the termination shall be coordinated with the Switchboard / Distribution Board to be installed. Any extension of conduit near the Switchboard / Distribution Board to suit the site condition shall be made without any extra cost. Conduit ends pointing upwards or downwards shall be properly plugged in order to prevent the entry of foreign materials. All openings through which concrete may leak shall be carefully plugged and boxes shall be suitably protected against filling with concrete. At all termination of concrete, soft bushes shall be fixed to prevent sharp edges of conduit ends from cutting or damaging the wires or cables to be pulled through them.

The entire conduit system shall be installed and tested before wiring is carried out. Any obstruction found shall be cleared by use of cutting mandrel or other approved device and the conduit shall be cleaned out before the installation of cable.

Pull boxes / Adaptable boxes shall be provided in conduit runs wherever required to facilitate pulling operation. The drawings are diagrammatic and do not indicate the position and spacing of pull boxes or adaptable boxes. However, these shall meet the following





requirements:

- Pull boxes.  
For straight runs the spacing shall not be more than 30 meters.  
For runs with one 90 degree bend, the spacing shall not be more than 15 meters.
- Adaptable boxes.  
For conduits up to 25 mm diameter, the boxes shall be 50 mm in depth.  
For conduits up to 40 mm diameter, the boxes shall be 63 mm in depth.  
For conduits up to 50 mm diameter, the boxes shall be 87 mm in depth.

Wherever the conduit lengths cross the expansion joint either along the column or slab, suitable arrangement shall be provided so that when the conduit lengths in the expansion joint are stressed, the conduit neither develops any cracks nor breaks down.

Bending, off setting and similar operations shall be performed through the help of proper bending tool to give a perfect bend of required angle without Desha ping of conduit to the least.

## 5.2 Steel and G.I Conduit

The minimum size of conduit shall be 20 mm.

The use of solid or inspection elbows, bends or tees will not be permitted and 120 degree bends shall be limited to one between any two drawn-in boxes.

Conduit coupling joint shall not be used where conduit enter spout entry boxes. Conduit running joints shall not be used where conduit enter conduit boxes or spout entry boxes.

Equipment that is required to be removed for maintenance shall be provided with conduit unions in all conduits that enter such equipment. The use of conduit nipples shall be avoided as far as practicable.

All conduits shall be cut square and reamed at the end. All conduit ends and the inside of conduits shall be clean and free from burrs.

Where bushed spouts or tapped holes are not provided at conduit termination, the conduit shall be terminated in a flanged socket and a smooth bore brass hexagon bush, with a lead washer fitted between the flanged socket and the equipment or box.

All exposed threads and parts where the galvanizing has become damaged shall be thoroughly cleaned and painted with galvanized paint. the exposed conduit ends shall be capped to protect threads from being damaged before installing cables.

Repair painting shall take place before any making good on site or buildings is carried out. The entire conduit system shall be checked for



continuity. Any observation found shall be removed without damaging the installation.

The conduit system shall be installed empty with an 16 SWG steel wire drawn through the conduits for pulling of cables. Joints in underground conduits shall be avoided or reduced to the absolute minimum.

Where adjustable dies are used they shall be so adjusted that threads cut with them shall be the same depths as machine made threads.

The use of manufactured bends shall be avoided and instead smooth bends shall be provided by using approved type of bending tools.

Flexible steel conduits shall be installed at all points locations where flexible connection is required, as directed by the Engineer. The flexible conduits when used, shall be protected by external PVC sheath, resistant to oil damages.

G.I. pipes for under ground installation shall be given bituminous paint coating and wrapped with suitable paper or cloth before installation.

### 5.3 Fixing of Conduits and Fittings

Conduits in process units and on steel work with "U" bolt type fixings.

Conduits in buildings shall be fixed with galvanized distance saddles. Where a number of conduits follow a single route they may be fixed to mild steel brackets.

Conduits shall be supported on both vertical and horizontal runs as follows:

- Conduits size 20 mm and 25 mm maximum spacing of fixing 1000 mm.
- Conduit sizes larger than 25 mm spacing of fixing 1500 mm.

All conduit boxes that support fittings shall be securely fixed. All conduits shall be fixed 150 mm before and after every right angle or off set. All conduit fittings and equipment shall be fixed true and line able. All conduit bends shall be made with an approved conduit bending machine or hickory. The radius of curvature of the inner edge of any bend shall not be less than the following table:

Conduit size	Radius
20 mm (3/4")	Not less than 130 mm.
25 mm (1")	Not less than 150 mm.
32 mm (1-1/4")	Not less than 200 mm.
38 mm (1-1/2")	Not less than 255 mm.
50 mm (2")	Not less than 305 mm.
70 mm (2-1/2")	Not less than 380 mm.
82 mm (3")	Not less than 460 mm.
100 mm (4")	Not less than 610 mm.

Under ground conduit stud-up or kick pipe through concrete envelope shall be extended a minimum of 150 mm above grade and adequately braced to prevent shifting during concrete pouring work. The concrete envelope shall extend at least 76 mm above grade. Under floor conduit installation shall be at a minimum depth of 120 mm from finished floor level. The G.I. pipes / conduits shall be installed at a minimum depth of 1000 mm measured from the top of size to the finished road level.

#### 5.4 Location of Conduits and Fittings

Before conduits are installed, confirmation shall be obtained that the conduit may be installed in that position.

Particular attention shall be given to the location of conduits to prevent the infringement of headroom and access ways.

Conduits shall be located to avoid obstructions, furnaces, hot lines and other places of high temperature.

Conduit shall not be located than 150 mm (6") where it runs parallel to or crosses hot surfaces. Under ground conduit runs shall be kept to minimum in both number and length. Conduits shall not be recessed in fair brick work.

Draw boxes shall be so positioned to enable the cables to be drawn in easily. The boxes shall not be located in the corners or other such locations and shall be positioned to avoid tight bends, bending and cable kinks.

Conduits shall not generally be installed having a greater length 12,000 mm (40 feet ) between draw-in boxes.

Conduit entries shall wherever possible be located in the bottom of boxes and equipment etc.



## SECTION - E - 5 WIRING ACCESSORIES

### 1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete switches, switch sockets, etc., and miscellaneous items as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with others for exact route, location and positions of electrical lines and equipment.

The wiring accessories shall also comply with the General Specifications for Electrical Works, Section - E - 1 and with other relevant provisions of the Tender document.

### 2.0 GENERAL

The locations of the wiring accessories such as sockets, switches etc. are tentatively shown on the drawings. The Contractor shall ensure exact positions and locations of wiring accessories in coordination with other services drawings, as per site requirements and as directed by the Engineer. The Contractor shall be responsible for proper functioning of wiring accessories after installation and Commissioning.

### 3.0 STANDARDS

Wiring accessories and miscellaneous items shall comply with Section - E-1, Clause 3. Particular reference shall be made to:

- BS 67 Ceiling roses.
- BS 1363: 1984 13A fused plugs and un-switched socket outlets
- BS 116 Two and three terminal ceiling roses.
- BS 2135 Capacitors for radio interference suppression
- BS 3676 Switch for domestic and similar purposes.
- BS 4934 Safety requirements for electric fans and regulators.
- BS 5060 Performance of circulating fans and their regulators.

Any other standard referred to in above standards or these specifications.

### 4.0 MATERIAL

#### 4.1 Switches

Switches for controlling light and fan points shall be single pole, rated for 10 Amp, 250 VAC. The body of switches shall be made of poly carbonate / urea with white face plate suitable for flush mounting on sheet steel outlet box. The switches shall be gang type having silver tipped contacts and operate with snap action.

For locations where switches and fan speed regulators are installed together, single switches shall be grouped and fixed on 3 mm thick plastic sheet screwed to a sheet steel box of appropriate dimensions. The fixing of plates on outlet boxes shall be means of flat head counter



sunk galvanized screws with the head of the screw finish flush with the surface of the plate. Except for switches controlling light points, all single switches for fans, sockets, etc., shall have identification symbols on the operating levers.

Two way switches shall be used to control lights from two different locations as shown on the drawings.

#### 4.2 Switch Socket Outlets

Switch socket units shall be of flat pin type and conform to BS 1363, 13A for fused plugs and socket outlets, 2 and 3 Pin rated for 5 Amps, or 2 Pin rated for 5 Amps. Supply as specified in the bill of quantities.

3 Pin 5 Amps. Sockets shall be moulded type having white plastic face plate, suitable for mounting on a sheet steel box of appropriate dimensions. Switch sockets shall have shrouded live contacts such that the earth pin is engaged to socket earth before making with the live contacts. Where specified, the switch socket unit shall have spring loaded dust tight cover for mechanical protection.

#### 4.3 Sheet Steel Boxes

The outlet boxes for installation of switches, fan speed regulators and socket outlets shall be 16 SWG sheet steel having appropriate dimensions. The boxes shall have suitable knockouts or welded nipples for receiving the conduits. An earth terminal shall be provided for connecting at least three earth wires of 4 sq. mm. The outlet boxes shall be given two coats of anti-rust red oxide and one coat of enamel before installation. The boxes shall be suitable for mounting flush with the surface of wall or on the surface of wall as may be required. The boxes shall not be less than 75 mm x 75 mm (3" x 3"). All boxes shall be water tight where installed in the vicinity of liquids.

#### 4.4 Ceiling Rose

The ceiling rose shall be suitable for 5 Amps, 250V AC. It shall have white plastic moulded base plate, copper or brass terminals for connecting at least two wires of 2.5 sq. mm size. The ceiling rose shall have a cover with cable inlet hole for multicore PVC insulated and PVC sheathed cable.

#### 4.5 Fans

##### 4.5.1 Bracket Type

The bracket type fans shall be suitable for mounting on the wall and suitable for operation semi-horizontally. These shall operate satisfactorily on 250 volts, single phase, 50 Hz, A.C. supply with  $\pm 10\%$  tolerance.

The sweep of the fan shall be as given in BOQ/drawings.

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed regulator, starting, radio



Interference, silent operation and temperature rise are concerned. For testing, BS 848 as amended shall be complied with.

#### 4.5.2 Exhaust Fan

The exhaust fans shall be three blade types, mounted on the steel/plastic structure of its own, which will be fixed to the structure by means of suitable grouted foundation bolts. The fan shall be suitable for operation on 250 VAC with + 10 % tolerance.

The sweep of the fan shall be as given in Schedule of Quantities/drawings. Fans shall be direct driven and supplied complete with electric motor, back draft dampers and anti-vermin screen. The bearings shall be ball, roller or sleeve type of permanently lubricated and sealed type. Wheels shall be heavily and rigidly constructed and accurately balanced both statically and dynamically and free from objectionable vibration or noises.

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed, speed regulator starting, radio interference silent operation and temperature rise is concerned. For testing BS 848 as amended 1 960 shall be complied with.

#### 5.2.3 Ceiling Fans

The ceiling fans shall be suitable for hanging from the ceiling. These shall operate satisfactorily on 250 volts, single phase, 50 Hz, A.C. supply with + 10 % tolerance.

The fans shall comply with BS 380 as far as constructional requirements, range of fan speed regulator, starting, radio interference, capacitor size, silent operation and temperature rise are concerned. For testing, BS 848 as amended shall be complied with.

## SECTION - E - 6 INTERIOR LIGHTING FIXTURES

### 1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete light fixtures as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and positions of light fixtures.

The light fixtures with accessories shall also comply with the General Specifications for Electrical Works, Section - E-1 and with other relevant provisions of the Tender document.

### 2.0 GENERAL

The description of light fixtures in given Bill of Quantities, and stated on the drawings, and relevant material are described in this section. The determination of quality is based on certified photo-metric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.

The Contractor shall submit two samples of each and every light fixture specified and obtain approval of the Owner before purchasing. The quality and finishes of local make light fixtures (if mentioned in BOQ) shall be same as that of standard manufacturer. The accessories such as ballast, lamp / starter holders, starters, lamps, ignitors, etc., for all type of light fixtures shall be of Philips make.

All fixtures shall be finished in standard colour schemes as mentioned in the manufacturer's catalogue for respective fixtures, unless specifically stated in the Specifications, Drawings or Bill of Quantities or directed by the Engineer.

### 3.0 STANDARDS

Lighting fixtures shall comply with Section E-1, Clause 3.

Particular reference shall be made to:

- IEC 81 Tubular fluorescent lamps.
- IEC 82 Ballast for tubular fluorescent lamps.
- IEC 155 Starters for fluorescent lamps.
- IEC 400 Lamp holders and starters holders for fluorescent lamps.
- IEC 566 Capacitors for use in TL, HP, Mercury and LP sodium vapour.
- IEC 598 Luminaires.
- BS 3677 Discharge lamp circuits.

Any other standard referred to in above standards or these specifications.

## 4.0 MATERIAL

### 4.1 Fluorescent Light Fixtures

The fluorescent light fixtures shall have lamps and ballast of proper rating as shown on the drawings. Each lamp shall be provided with independent ballast.

The fluorescent lamps shall be tubular, 1224 / 610 mm long, for TL 28 / 14 watts respectively as specified. The fluorescent colour shall be warm white characteristics with an average output of 3350 lumens (+5%) for 28 watts and 1350 lumens (+5%) for 14 watts after 100 burning hours. The ballast shall be electronic type for 28 / 36 watts ballast. A wiring, diagram, wattage, voltage and current figures shall be printed on the body of the ballast.

The lamp holders shall be rotary lock-in type. The starters shall be glow type with radio interference suppressor / by-pass capacitor. The internal wiring of the fluorescent light fixtures shall be done with heat resistant wires at the manufacturer's factory. All light fixtures shall be provided with power factor improvement capacitor to give a minimum power factor of 0.90.

The body of the fluorescent light fixtures shall be minimum 22 SWG sheet steel, derusted, degreased, finished in heat resistant paint, stove enameled. Appropriate size bushed wire entry holes, fixing holes and earth terminals shall be provided. Connectors suitable for connecting 2.5 sq. mm cable connectors shall be provided for supply connections. An earth terminal for connection to 14 SWG copper conductor shall be provided.

The light fixtures shall be furnished with perspex diffusing panels " 040 opal acrylic" (minimum sheet thickness 3 mm), polystyrene louvers or metal grid louvers or mirror optic reflectors, etc. as specified on the drawings or in BOQ. The louvers shall be secured firmly and in level. The polystyrene louvers shall be white Egg Crate or as approved. The louvers shall be in one section and not in pieces.

The design of light fixture for recess mounting shall be coordinated with the design of false ceiling prior to commencement of manufacture. Shop drawings shall be submitted for approval of Engineer.

### 4.2 LED Light Fixtures

The light fixture shall be as stated on drawings and bill of quantities. The light fixture shall be finished in standard colors unless otherwise stated on drawings or directed by Engineer. All LED light fixtures shall be of international standard and quality. The type of fixtures with manufacturer catalogue reference is given on the fixture schedule and in B.O. of Quantities. Equivalent fixture may be acceptable provided that the Contractor submits for review all necessary data indicating photometric curves to show that the fixture proposed are of the same type, construction and quality.



The lamps for light fixtures shall be Light Emitting Diodes with driver and shall be supplied and installed according to the wattage as indicated on drawings.

Weather proof light fixture shall comprise of cast aluminum body and gasketed clear glass cover secured to the body by means of galvanized nuts / screws to give a weather proof and water tight fit. The gasket shall be weather resistance type.

The LED light fixtures shall be supplied complete with driver and all accessories as per light fixture schedule and shall be installed in accordance with manufacturer's recommendations and sound engineering practice.

## 5.0 INSTALLATION

### 5.1 General

The mounting heights of light fixtures are indicated on the drawings, and position of fixtures according to the mentioned scale.

The Contractor must ensure that the light fixtures are installed uniformly with respect to the dimensions of the area. Any modifications due to site conditions may be made with the approval of Engineer. All fixtures shall be carefully aligned before fixing in position. All fixing accessories such as ceiling rose, flexible cord, lamp holder, suspension rod, pipe or chain with suitable canopy, etc., shall be provided and installed.

The wiring between terminal box and the fixture shall be carried out with 3 core 0.75 sq. mm and 1 sq. mm copper conductor, PVC / PVC cable respectively for circuits protected by 10 amps and 15 / 20 amps MCBs. The wiring inside light fixture body shall be done with heat resistant cables or PVC insulated cable in heat resistant sleeves as approved by the Engineer.

Glasses, shades, reflectors, diffuses, etc., must be in a clear condition after installation.

All light fixtures shall be earthed by an earth wire connected to the earth terminal in the fitting.

### 5.2 Fluorescent Light Fixtures

The fluorescent light fixtures on the surface of ceiling shall be installed with the back of the body flush with the ceiling surface, and in a manner so as to facilitate wiring. Nylon plugs and galvanized steel bolts or screws shall be used for fixing the light fixture to the ceiling. For light fixtures on installation on false ceiling, the installation method detail shall be coordinated with ceiling design and submitted for approval of Engineer. Care shall be taken to prevent the weight of the fixture from being transferred to the false ceiling.

Pendant light fixtures shall have two holes in the top of each casing by a 1/4" diameter galvanized pipe or any other standard method as approved by the Engineer. Wiring from ceiling rose to the fixture shall be installed through the pipe. Proper arrangements such as long threads with check nuts, etc. for minor adjustment in the mounting heights of the fixtures shall also be provided.

### 5.3 LED/CFL Light Fixtures

The LED and CFL light fixture shall be installed on the surface of ceiling or wall by means of nylon plugs and galvanized steel screws, such that their back finish flush with the surface for exposed conduits and flush with outlet box for concealed conduit system. Wherever convenient, screws for fixing light fixtures shall be screwed into the holes of the outlet box. The light on false ceiling shall be installed in accordance with manufacturer's recommendations and in coordination with ceiling installation.

### 5.4 Outdoor Lighting

For illumination around buildings during dark hours, light fittings in various arrangements shall be provided in accordance with these specifications. The items not shown on drawings or called for, but which are necessary for a complete working system as required, these shall also be provided and deemed to have been considered as such.

The Contractor shall essentially use the standard products of a manufacturer regularly engaged in the manufacture of the product and shall meet the requirement of the specifications.



## SECTION – E – 7 CABLE TRAY, LADDER AND TRUNKING

### 1.0 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 2.0 SUBMITTALS

General: Submit the following according to the Division 1 Specification Sections.

Product data for each component. Show tray types, dimensions, and finishes. Determine the sizes of the cable trays based on the number and size of cables laid on the cable trays plus 20% space for future growth. Cables laid on cable trays shall be spaced twice their overall diameter (consider the largest cable as reference). In case of discrepancy with the contract documents this clause shall prevail, unless approved by the Engineer otherwise.

Shop drawings detailing fabrication and installation of cable tray, including plans, elevations, sections, details of components, and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice plates, connectors, expansion joint assemblies, straight lengths, and fittings.

Co-ordination drawings, including floor plans and sections drawn to accurate scale. Show accurately scaled cable tray layout and relationships between components and adjacent structural and mechanical elements.

### 3.0 QUALITY ASSURANCE

Manufacturer Qualifications: Select a firm experienced in manufacturing cable trays which has a record of successful in-service performance.

Comply with the relevant standards of BS, NEMA and NEC.

Single-Source Responsibility: All cable tray components shall be the product of a single manufacturer.

### 4.0 SEQUENCING AND SCHEDULING

Co-ordination: Co-ordinate layout and installation of cable tray with other installations.

Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Engineer.

### 5.0 CABLE TRAYS

The cable tray system shall be of one manufacturer and shall include factory made trays, tray fittings, connections and necessary accessories and supports to form a complete tray support system.

The cable tray system shall include the following factory made tray elements. Straight trays and ladders, fittings and horizontal and vertical bends of various angle crosses, tees, wyes, reducers, vertical riser elements, connectors and a l

necessary fixing accessories.

Cable trays shall be constructed from mild steel of minimum thickness 16 gauge (1.5 mm). Trays in excess of 300 mm width shall be of minimum thickness 14 gauge (2.0mm).

Insert elements, bolts, screws, pins etc., shall be mild steel cadmium plated.

- a. Tray work shall have oval perforations. Ladder type trays shall be used as required and/or approved by the Engineer.
- b. All trays (straight and fittings) to be heavy duty returned flanged type unless specified otherwise.
- c. Tray components are to be accurately rolled or formed to close tolerance and all edges rounded. Flanges are to have full round smooth edges.
- d. Ladder racks of widths up to and including 300mm shall be constructed from rolled steel sections of minimum thickness 16 gauge (1.5 mm). Ladders in excess of 300 mm width shall be C Section construction with a minimum thickness of 14 gauge (2.0mm). The rungs shall be spaced at a maximum 300 mm.
- e. Unless indicated otherwise on drawings, cable trays shall be used in the range 150 mm to 900 mm wide, in the preferred standard sizes: 150, 300, 450, 600 and 900 mm.
- f. Other sizes shall be used where specified or previously agreed with the Engineer.
- g. Flanges shall be a minimum of 50 mm deep.
- h. Minimum radius at side rails, horizontal and vertical tees and crosses shall be in accordance with the Manufacturer's standard.

Perforated, heavy duty, return flange type, in 2.5m nominal lengths hot dip galvanized after completion of bending and drilling, complete with a necessary purpose made bars, tees, supports and the like. Width shall be such as to permit adequate access for installation and maintenance of cables and per the requirements of KESC regulations.

## 6.0 CABLE TRUNKING

Where required, wiring shall be run in hot-dipped galvanized (after fabrication) sheet steel cable trunking of the specified gauge complete with all fittings and accessories, manufactured and installed in accordance with BS 4678/NEMA. The trunking shall be constructed with return flanges. Trunking covers shall be secured by anchored turn-buttons and locking bars and minimum length of individual sections shall be 2.44-m. The trunking shall be suspended/supported from the structure at maximum 2-m intervals with straps and hangers fabricated from minimum 6-mm dia HDGF bars, or supported by angle-iron brackets.

Conduit drips from the trunking shall also be supported with hangers. Factory made connectors shall be used at joints.

Junctions (tee and 4-way) in multi-compartment trunking shall be double depth to avoid reduction in cabling space. Cable in vertical runs shall be supported by pin racks, brangs or bracing pieces. Fire barriers shall be



provided at each floor level. Allowance for expansion shall be incorporated.

Bonding links shall be provided at each joint and secured by screws, nuts and shockproof washers. The bonding links shall make contact with the metal of the trunking or fitting, and continuity shall not depend on contact through the screws, nor on removal on site paint finish from ferrous metal.

#### **7.0 EXAMINATION**

Examine surfaces to receive cable tray, cable trunking and cable ladder for compliance with installation tolerances and other required conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **8.0 WIRING METHODS**

Use cable tray or cable ladder with manufacturer's recommended covers, carrier strips, dropouts, fittings, conduit adapters, hold-down devices, grommets, and blind ends.

#### **9.0 INSTALLATION**

- a. Install cable tray, cable trunking and cable ladder level and plumb according to manufacturer's written instructions, rough-in drawings, the original design, and referenced standards.
- b. Remove burrs and sharp edges of cable trays.
- c. Make changes in direction and elevation using standard fittings.
- d. Make cable tray connections using standard fittings.
- e. Locate cable tray above piping except as required for tray accessibility and as otherwise indicated.
- f. Fire stop penetrations through fire and smoke barriers, including walls, partitions, floors, and ceilings, after cables are installed.
- g. Working Space: Install cable trays with sufficient space to permit access for installing cables.

#### **10.0 GROUNDING**

Connect cable trays, cable trunking and cable ladder to ground as instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors.

#### **11.0 CLEANING**

Upon completion of installation of system, including fittings, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes, including chips, scratches, and abrasions.



## SECTION - E - 8 ADDRESSABLE FIRE ALARM SYSTEM

### 1.0 SCOPE OF WORK

The work under this scope consists of supplying, installation and commissioning of all material and services of the complete Addressable Fire Alarm system as specified herein and / or shown on the Tender Drawings and given in the Bill of Quantities.

The Contractor shall discuss the electrical layout with the Engineer and coordinate at site with other services for exact route, location and positions of the system.

The Fire Alarm system with accessories shall also comply with the General Specifications for Electrical Works, Section E - 1 and with other relevant provisions of the Tender document.

### 2.0 STANDARDS

The latest editions of the following standards / codes shall be applicable for the materials covered within the scope of this specification:

BS 5839, EN approved  
NFPA 72

Any other standard referred to in above standards or these specifications.

### 3.0 OPERATION

The Fire Alarm System shall be analogue addressable type complete with battery standby power. MFACP have provision to monitor/interfaced with client area FACP for full proof monitoring.

At locations indicated in the drawings the break glass type fire alarm Control Panel, Repeater Panel and automatic detectors shall be installed. In case of any Fire, the manual station shall be operated by pulling down the handle or breaking glass. The actuation of this station shall cause an audio as well as visual alarm at the fire alarm control and indication unit, duly indicating the location of the respective station/zone.

An authorized person shall immediately visit the effected area and if after investigating, it is deemed necessary, alarm in the whole building shall be initiated from either the alarm switch located beside the fire alarm control panel by inserting a special key or the actuation of any indication at the Fire Alarm Control Panel. The general alarm shall be initiated by an authorized person after inspecting the affected location.

Circuit shall be so arranged that an open circuit in any initiating or indicating loop shall cause the individual zone and common trouble indication at the fire alarm control panel.

**4.0 MATERIAL****4.1 Conduit and Conduit Accessories**

The specifications for conduit and conduit accessories shall be same as given for electrical conduit in Section E - 5 of these specifications.

**4.2 Fire Alarm Cable**

Fire Alarm Cable shall be 2 core 1.5mm shielded twisted pair, fire resistant, PVC insulated 250/440 volts grade cable to be laid in concealed PVC conduit.

**4.3 Power Supply**

The supply and operating voltages shall be 220 volts, 50 c/s and 24 volts D.C. respectively. The control stations shall be provided with sufficient capacity nickel cadmium battery with charger to operate the complete system for the least 3 hours in case of mains failure.

**4.4 Fire Alarm Control and Indication Unit**

The fire alarm control and indication unit shall be a Solid State Modular Unit consisting of the following Modules; suitable number of modules shall be used to provide facility for 6 loops. It shall not be possible to remove the key without turning the key to its normal position, thus resetting the alarm contacts.

**i. Loop Module**

Loop Module shall have multiple of supervised initiating circuit with a trouble and an Alarm Lamp for each loop. Detection circuit wiring shall be two wire Class 'A' and shall power all Detectors (Relay outputs and) voltage output for each zone alarm and voltage output for each zone trouble shall be provided.

**ii. Audible Expander Modules**

Audible Expander Modules shall provide for supervised control circuit for polarized alarm signaling devices. Loop activated lamp shall be provided for each loop to aid on system testing and trouble-shooting provide (1) (2) (3) indicating circuits.

**iii. Power Module**

Power Module shall supply the necessary power for the loop module and all Detectors (and shall contain a Battery Charger to charge the batteries) An AC power to Lamp shall be provided to indicate the normal condition of the panel. Individual supervisory lamps shall be provided for AC power failure indication, ground fault detection, and low battery. All controls shall be behind a key-locked door to prevent unauthorized operation. Two supervised control circuits for audible signaling shall be provided as part of this module. Common trouble and common alarm relay and logic outputs shall be provided. The panel cover shall be key-locked to prevent unauthorized access.

#### 4.5 Addressable Manual Break Glass Station

The break-glass manual station shall be operated by pulling down on the handle. When operated, the handle shall remain down with the pre-signal alarm contacts closed until the station is reset. The general alarm contacts shall remain open until after investigation. The general alarm switch shall be operated by an authorized person with a special key.

#### 4.6 Addressable Audible Signal Unit

Fire alarm sounder with strobe shall be red color surface mounted installed where indicated on the drawings. Sound intensity shall be such that an audible signal will be heard clearly throughout the structure when the entire bells ring. The bell shall be connected in multiple cross loop conductors.

#### 4.7 Addressable Smoke Detector:

The Smoke Detector is optical type and shall be connected to the specific loop. Base shall be provided with detector.

#### 4.8 Addressable Heat Detector:

The Heat Detector is connected to the specific loop. Base shall be provided with detector.

#### 4.9 Annunciator if required

The remote visual annunciator shall have the capacity for indicating 6 distinct alarm loop and one common trouble condition. The annunciator shall be back lighted type to increase visibility and to deter tampering with the lamps. The descriptions of each zone shall be approved by the Engineer Incharge. In the normal condition the annunciator shall have a blank appearance. Alarm and trouble condition shall be annunciated both visually and audibly. Lamp shall be 24 V DC, and replacement shall be readily available. Lamp replacements shall be accomplished without tools.

A test switch shall be provided for periodic testing of all lamps in the annunciator. To reduce tampering the annunciator shall have a key operated silence switch and a key locked cover. For aesthetic reasons the unit shall be compact, have a brushed metallic trim ring and be surface mounted.

#### 4.10 Function of Addressable Fire Alarm Control Panel (FACP)

##### i. Design

The FACP shall be solid state, modular design with integral static protection. All indicating lamps shall be long-life, low maintenance solid state light emitting diodes (LED).

##### ii. Enclosure

The FACP enclosure shall be semi-rush mounted. The enclosure shall be hinged from the left and the cover shall have clear





windows and locking mechanism to keep the system operating and status switches from being tampered keys shall be made available to fire department and other authorized operating personnel. Finish shall be "FIRE ALARM RED" and "BLACK".

iii. **Loops & Identification**

All controls shall be labeled, all loop locations shall be identified, and the FACP shall be provided with a set of permanently mounted operating instructions, to avoid confusion. Loop location identification shall be as approved by the Engineer incharge and contain up to three lines of text with 1/8" minimum character heights.

iv. **Components of Fire Alarm Control Panel**

The FACP shall include as minimum following:

- a. All hardware and software to allow the panel configuration and operation to be changed at the panel. Systems that require off-site programming are not acceptable.

The memory data for panel configuration and operation shall reside in non-volatile, memory provided by battery-backed RAM. Removal of the board shall not cause loss of memory contents.

Switches for panel setup, set reset, manual, evacuation alarm, silence and acknowledge. Individual supervisory LEDs shall be provided for power, run, alarm, trouble, disconnect, low battery and ground fault.

- b. Indicating zones: As indicated on the drawings, each zone containing smoke detectors shall provide power and monitoring for up to only 50% detectors. (All hardware and software shall be provided to facilitate selection of circuit performance to provide alarm verification for smoke detector circuits with field false alarms. When a detector signals an alarm, the panel shall automatically reset the detector, wait and their double checks to verify the alarm. Each zone shall have a red LED to indicate alarm and yellow or amber LED to indicate a trouble condition.
- c. Indicating Loops: 1 or 2 indicating circuits shall be provided. Each circuit shall provide power for polarized alarm signaling devices. A red LED to indicate the energized state of the circuit and a yellow LED to indicate a trouble condition shall be provided for each circuit. A disconnect switch for each circuit shall be provided to allow the FACP to be tested with sounding alarm signals. When disconnected, the FACP shall

indicate both trouble condition and disconnect.

#### v. Manual Functions

At any time, even without an alarm condition on an indicating circuit, the operator shall provide the following manual capabilities in the FACP by means of switches located behind a key-locked cover:

- a. In case of fire if a general evacuation is needed all bells shall sound. These signals can be initiated from the main panel and secondary switch at manual fire alarm initiating device (break glass unit).
- b. Silence the local audible signal. This shall also cause the LED(s) to cease flashing and to be continuously 'ON'.
- c. Silence the alarm signals.
- d. Reset the FACP, after all initiating devices have been restored to normal.
- e. Disconnect any individual initiating or indicating circuit from the alarm sequence. This action shall light a disconnect LED and cause a trouble condition.
- f. Perform a complete operational test of the system microprocessor with a visual indication of satisfactory communication with each board.
- g. Test all panel LEDs for proper operation without causing a change in the condition on any zone.

#### vi. System Supervision

- a. Upon application of primary power, or reapplication following power failure, the FACP shall automatically be in a normal supervisory condition.
- b. In the normal supervisory condition, a green "POWER" LED shall be illuminated, indicating the presence of primary power.
- c. A green "RUN" LED shall be illuminated indicating that the microprocessor is communicating with the system and the memory contents are satisfactory.
- d. The following shall be electrically supervised:

All initiating and indicating device circuits.

All plug-in circuit board shall have proper board type in the position.  
System that use electrical continuity to supervise the presence of plug

boards, but that do not assure that board position have been exchanged, shall provide equivalent means for specified supervision, beyond that provided by the locked cover.

#### 4.11 Shop Drawings / Technical Specifications

Prior to installation of any equipment, the Contractor shall submit for approval, shop drawings including riser and terminal wiring diagrams and specifications data sheets. Submittals indicating typical one line riser and typical specification data sheets only will not be acceptable.

The Contractor shall review the total system point to point wiring layout to assure that the correct number and type of wire and conduit sizes are installed.

Upon completion, the Contractor shall provide detailed written operation instructions and three sets of "as built" drawings including plan, layout, conduit runs and wiring diagrams as finally installed.

#### 4.12 Test

Upon completion and at such time as the Engineer incharge may direct, the Contractor shall conduct a total system test where line supervision and each device shall be tested. All the tests shall demonstrate that the system meets the tests shall operating requirements of this specification, that individual conductors of all circuits are free of grounds, shorts and breaks, and that no grounds exist between any piece of equipment in the control unit and the cabinet. All final connections, testing, adjusting and calibrating shall be made under the direct supervision of a factory trained technician of the system supplier.

#### 4.13 System

The fire alarm control panel (FACP) shall be installed at the Security room at lower ground floor by at a position and height as shown on drawing and as approved at site. The FACP shall match with the wall finish and shall be of neat finish, installed flush or semi-flush with the wall.

The fire alarm riser shall travel in one conduit for straight runs, separate conduit shall be used at branch office through junction boxes.

#### 4.14 Fire Alarm Installation

The Fire alarm system shall be installed as mentioned in the drawings. The system shall be connected, tested and commissioned as per manufacturer's instructions and in the presence of Engineer incharge. The wall recessed mounting Fire alarm manual stations shall be installed at a height of 4.5' feet above finished floor level. The connections of the appropriate Contactors of the Fire alarm system shall be made as per manufacturer's instructions.

The mounting height of the sounder shall be above the false ceiling or 7' from F.F. level when false ceiling is not comes. The conduit and wiring of the fire alarm system shall be as per installation instructions for



conduits and wirings given in the relevant section of these specifications. The Fire alarm system conduit shall be laid 15 cms (6") from the electrical conduits and cross the electrical conduit at 90 degree only. The Fire alarm system conduit shall be marked with red colour at terminations in order to distinguish it from other conduit system.



### LIST OF APPROVED MANUFACTURER

**\* All Equipment shall be procured from Principal Authorized agents / distributors / resellers**

The Bidder shall fill name of only one manufacturer for each equipment/material on which the tender is based. He shall be bound to supply the equipment from the same manufacturer. In case, the Bidder gives names of more than one manufacturer against any equipment, the Engineer / Owner can ask the Bidder supply the equipment from any one of them.

At the evaluation stage if it is noted that any material offered by the bidder does not meet the specification requirements, the Engineer / Owner reserves the right to ask the bidder to replace his choice of equipment supplier meeting the required quality and specification requirement.

During the execution stage if the material from any supplier is found defective / substandard the Engineer / Owner reserves the right to ask the successful bidder to replace his choice of manufacturer / supplier for that particular equipment.

Any change in manufacturer / supplier shall only be entertained if there is sufficient reason that adhering to the original choice of manufacturer / supplier shall be detrimental to either the project quality or project timeline. Proper approval shall have to be sought for change in the choiced manufacturer / supplier at least 1 month before the equipment is to be procured.

Samples of all equipments shall have to be got approved prior to their procurement. The bidder has to sign and stamp all pages of Annexure-1. Any deviation from the BoQ / Specification shall be listed in a separate sheet to be labeled as Annexure-2 containing the details of the deviation including the deviating BoQ item number.

S.No.	Manufacturer / Supplier	Country Of Origin
-------	-------------------------	-------------------

### LOW VOLTAGE (LV) PRODUCTS

#### LV Switchboards / Distribution Boards / PFI Panels

- |    |                         |          |
|----|-------------------------|----------|
| a. | Schneider Electric      | Pakistan |
| b. | PEL                     | Pakistan |
| c. | Babar Brothers Engg. Co | Pakistan |

#### Circuit Breakers

- |    |                           |                 |
|----|---------------------------|-----------------|
| a. | M.G. (Schneider Electric) | France / Italy  |
| b. | Legrand                   | France          |
| c. | ABB                       | Germany / Italy |
| d. | General Electric (GE)     | UK/USA          |

Load Break Switches, Changeover Switches

- |    |                |         |
|----|----------------|---------|
| a. | Socomec        | France  |
| b. | Kraus & Naimer | Austria |

Push Buttons, Switches, Etc.

- |    |                    |                                 |
|----|--------------------|---------------------------------|
| a. | Schneider Electric | France / Italy                  |
| b. | Maruyasa           | Japan / Malaysia /<br>Indonesia |

L.V. Cables & Wires

- |    |                 |          |
|----|-----------------|----------|
| a. | Pakistan Cables | Pakistan |
| b. | Indus Cables    | Pakistan |
| c. | Allied Cables   | Pakistan |

Cable Glands, Lugs, Terminals and Accessories

- |    |                 |    |
|----|-----------------|----|
| a. | Cembre          | UK |
| b. | Hubbell / Hawke | UK |

PVC Conduits and Accessories

- |    |                |          |
|----|----------------|----------|
| a. | Galco          | Pakistan |
| b. | Dadex          | Pakistan |
| c. | Jeddah Polymer | Pakistan |

Back Boxes

- |    |                           |          |
|----|---------------------------|----------|
| a. | Hussain & Co.             | Pakistan |
| b. | Babar Brothers Engg. & Co | Pakistan |
| c. | Hensel                    | Germany  |

Switch & Socket Outlets / Floor Boxes

- |    |                              |                       |
|----|------------------------------|-----------------------|
| a. | Clipsal (Schneider Electric) | Australia / Singapore |
| b. | Orange                       | Srilanka              |
| c. | Legrand                      | France/UK             |
| d. | ABB                          | Germany               |

FAN & Accessories

- |    |            |          |
|----|------------|----------|
| a. | Pak Fan    | Pakistan |
| b. | GFC Fan    | Pakistan |
| c. | Millat Fan | Pakistan |



Lighting Fixtures

- a. Philips
- b. Pierlife
- c. Britlite
- d. Green Tech

Netherland/Pakistan  
Australia/Pakistan  
China/Pakistan  
China/Pakistan

Cable Tray / Trunking

- a. A la Zee
- b. Premier Engineering
- c. Babar Brothers Engg. & Co

Pakistan  
Pakistan  
Pakistan

LOW CURRENT PRODUCTS

Fire Alarm System

- a. Gent by Honeywell
- b. Esser By Honeywell
- c. Ziton
- d. Morley

UK  
UK  
UK  
UK/USA

## ABSTRACT OF COST





**REVAMPING OF EXISTING PROVINCIAL ASSEMBLY BUILDING KARACHI  
(PACKAGE-II PHASE-II)**

**ABSTRACT OF COST**

1.	Cost of Civil Works	....	Rs. ....
2.	Cost of Plumbing Works	....	Rs. ....
3.	Cost of Electrical Works	....	Rs. ....
4.	Cost of HVAC Works	....	Rs. ....

**Total Cost of Project Rs. ....**

(Rupees ..... Only)

BILL OF QUANTITIES  
CIVIL WORK



**REVAMPING OF EXISTING PROVINCIAL ASSEMBLY BUILDING KARACHI  
(PACKAGE-II PHASE-II)**

**SUMMARY OF COST  
(CIVIL WORKS)**

1	DISMANTLING	.... Rs.	_____
2	BLOCK MASONRY	.... Rs.	_____
3	PLASTERING & RENDERING	.... Rs.	_____
4	FLOORING / SKIRTING / DADO	.... Rs.	_____
5	MARBLE	.... Rs.	_____
6	FALSE CEILING:	.... Rs.	_____
7	PAINTING	.... Rs.	_____
8	SURFACE RENDERING	.... Rs.	_____
		<b>TOTAL RS.</b>	<u>_____</u>

( Rupees \_\_\_\_\_ Only)

\_\_\_\_\_  
Signature & Seal of Contractor

**REVAMPING OF EXISTING PROVINCIAL ASSEMBLY BUILDING KARACHI  
(PACKAGE-II PHASE-II)**

**BILL OF QUANTITIES  
(CIVIL WORKS)**

It. #	Description of Items	Unit	Quantity	Rate	Amount
<b>1.00</b>	<b><u>DISMANTLING:</u></b>				
1.01	Providing all labour, tools and plants for dismantling of masonry any type wall, bathrooms partition walls, vanity, any type flooring and removal of any type tile etc. at any floor any height including disposal of debris at places permitted by Civic Agencies complete as per drawing, specification and as directed by the Engineer.				
(a)	At any height & floor.	Sft.	50,000		
(b)	Roof screeding dismantling & removal.	Sft.	44,000		
				<b>SUB TOTAL RS.</b>	
<b>2.00</b>	<b><u>BLOCK MASONRY:</u></b>				
2.01	Placing & laying first class solid block masonry set in cement mortar 1:4 in straight or curved wall including scaffolding, raking out joints and curing etc. at any height complete as directed by Engineer/ Consultant at any height and floor. c) 4" thick	Sft.	1,000		
				<b>SUB TOTAL RS.</b>	
<b>3.00</b>	<b><u>PLASTERING &amp; RENDERING:</u></b>				
3.01	Applying cement plaster on Columns, Beams, Walls etc. straight or curved surfaces upto any height including curing scaffolding, cutting etc. complete as per drawing complete in all respect as approved by Engineer/ Consultant. a) 1/2" thick, ratio 1:6 (Internal Wall).	Sti	2,000		
				<b>SUB TOTAL RS.</b>	
<b>4.00</b>	<b><u>FLOORING / SKIRTING / DADO</u></b>				
4.01	Providing and fixing best quality imported made porcelain tiles flooring RAK GRANITTO or WHITE HORSE or equivalent of size 24" X 24" or approved any other size in approved shade and design with 2" thick base CC 1:2:4 concrete, using O.P. cement unless other wise notified, setting tiles in cement slurry / dry bond "Master", "Style" or equivalent and grouted the joints with "Style" grouted with admixture and sealer including washing, cleaning and curing Complete in all respect and as per drawings and instructions of the Engineer/Architect. At any height and floor.	Sft.	21,000		
4.02	providing & fixing best quality imported made Porcelain Tiles Skirting RAK GRANITTO or WHITE HORSE or equivalent 24" x 4" or any other approved size in approved shade and design over 1/2" thick base CC 1:4 concrete, using O.P. Cement unless otherwise notified, setting Tiles in cement slurry / dry bond "Master", "Style" or equivalent and grouted the joints with "Style" grouted with admixture and sealer including washing, cleaning and curing complete in all respect and as per drawings and instructions of the Engineer / Consultant. (At any height and any floor)	Rft.	2,950		

It. #	Description of Items	Unit	Quantity	Rate	Amount
4.03	Providing and fixing best quality <b>imported made ceramic tiles flooring</b> RAK GRANITTO or WHITE HORSE or equivalent 10" x 12" or approved any other size in approved shade and design with 2" thick base CC 1:2:4 concrete, using O.P. cement unless other wise notified, setting tiles in cement slurry / dry bond "Master", "Style" or equivalent and grouted the joints with "Style" grouted with admixture and sealer including washing, cleaning and curing Complete in all respect and as per drawings and instructions of the Engineer/Architect. (At any height and any floor)	Sft.	2,850	285.00	
4.04	Providing and fixing best quality <b>Local made ceramic tiles Skirting / Dado</b> RAK GRANITTO or WHITE HORSE or equivalent 10" x 12" or approved any other size in approved shade and design with 1/2" thick base CC 1:4 concrete, using O.P. cement unless other wise notified, setting tiles in cement slurry / dry bond "Master", "Style" or equivalent and grouted the joints with "Style" grouted with admixture and sealer including washing, cleaning and curing Complete in all respect and as per drawings and instructions of the Engineer/Architect. At any height and any floor.	Sft.	9,750		
<b>SUB TOTAL RS.</b>					
<b>5.00</b>	<b>MARBLE</b>				
5.01	Providing & fixing best quality 3/4" Granite flooring 2' x 2' and in different sizes of approved shade, as per drawing fixed / layed with dry bond / OP Cement slurry and filling the joints as required with white / matching pigment cement grinding, laser cutting, rubbing, chemical polishing the quoted covering all escalation in price (inflation) complete in all respect and as per drawings and instructions of the Engineer / Architect. At any height and any floor.				
	a) Corridor	Sft.	29,500		
	b) At Staircase Floor	Sft.	2,000		
5.02	Providing and fixing best and approved quality BOTICINA marble tread with GRANITE, reflected grains noze on stair steps 1'-0" x 5'-0" and 3'-4" thick of 6" high of approved shade with concrete base 1:3 including cost of washing, cleaning, curing and chemical polish. Complete in all respect and as per drawings and insturections of the Engineer/Architect. At any height and any floor.				
	a) Tread	Sft.	2,850		
	b) Landing	Sft.	1,750		
	c) Riser	Sft.	1,200		
5.03	Providing and fixing best and approved quality BOTICINA (CRHAM) marble, stair riser 6" high, 3/8" thick of size 2'-6" X 6" of approved colour with base concrete 1:3 including cost of washing, cleaning, curing and chemical polish. Complete in all respect and as per drawings and insturections of the Engineer/Architect. At any height and any floor.				
	a) Steps - Entrance to Passage	Sft.	1,750		
	b) Risers - Entrance to Passage	Sft.	750		

It. #	Description of Items	Unit	Quantity	Rate	Amount
5.04	Providing & fixing size (width) 3/4" thick Granite with 1/2" deep Groove for Verandah. Dado with 3/4" thick C.C. base upto 3'-0" high. Complete in all respect and as per instructions of the Engineer/Architect. At any height and any floor.	Sft.	8,600		
				<b>SUB TOTAL RS.</b>	
<b>6.00</b>	<b><u>FALSE CEILING</u></b>				
6.01	Providing & fixing of FALSE CEILING size 2' x 2' x 12mm thick of approved pattern, laid on exposed suspension system comprising of imported, aluminum, white, powder-coated Tee suspended by wire of SWG 18 OR adjustable rods thru butterfly adjusters screwed to soffit at any elevation as per reflected ceiling plan. Complete in all respect and as per drawings and instructions of the Engineer/ Architect. (At any height and any floor)	Sft.	16,000		
				<b>SUB TOTAL RS.</b>	
<b>7.00</b>	<b><u>PAINTING</u></b>				
7.01	Providing & applying 3 coats of Distemper Paint on ceiling including applying a coat of primer preparation of base complete as per direction of Engineer / Consultant. At any height and floor.	Sft.	75,000		
7.02	Providing & applying 3 coats of Plastic Emulsion / Mat Finish paint of approved quality and shade to walls, beams, columns etc. including applying a coat of primer preparation of base complete as per direction of Engineer / Consultant. At any height and floor.	Sft.	185,000		
				<b>SUB TOTAL RS.</b>	
<b>8.00</b>	<b><u>SURFACE RENDERING:</u></b>				
8.01	Cleaning & washing colour crete wall outer surface including scaffolding etc. complete as per direction of Engineer / Architect. At any height and floor.	Sft.	60,000		
8.02	Providing & applying SIKKEN polish of Holland or equivalent finished on Teak wood doors, windows and ventilators as shown in drawing at any height and floor complete in all respect and as per drawings & instructions of the Engineer / Architect.	Sft.	44,400		
8.03	Providing & fixing MDF wood partition wall using 3" x 1-1/2" thick verticle main frame 3" x 1-1/2" horizontal bracing frame over 1/2" thick MDF praising both side. Complete in all respect and as per drawings and instructions of the Engineer/Architect.	Sft.	3,500		
8.04	Providing & laying 2.5" thick (Average) 1:2:4 screed laid to proper slopes in panels not exceeding (4'-0" x 4'-0") to be smooth finish etc. complete in all respect at any height and floor as per drawing specifications (On Top Roof).	Sft.	44,000		

It. #	Description of Items	Unit	Quantity	Rate	Amount
8.05	Providing & fixing 4mm thick waterproofing membrane on roof as per Manufacturer's specification on smooth surface proper overlapping and hot flame sticking complete with all respect as per direction of Client / Consultant. At any height and floor.	Sft.	44,000		
8.06	Providing all tools and plants, skilled labour & Helper for repairing wood work / doors and windows, ventilators as per instructions of Client / Consultant and specification. At any height and floor.	Sft.	3,000		
8.07	Providing & fixing insulation tiles (HRNT-613) flooring on roof area of approved shade as per drawing fixed / laid with dry bond / OP Cement slurry and filling joints as required with white / matching pigment cement, the quoted price covering all escalation in price (inflation) complete in all respect and as per instruction of Engineer / Architect. (At any height and floor)	Sft.	44,000		
8.08	Making CC Chamber 8" wide for water drainage 6" to 18" deep from top surface at top 10" wide M.S. Grating including 1-1/4" angle 1/4" square bar welding, colouring, jointing welding joint should be smooth complete with all respect as per drawing and direction of Client / Consultant.	Rft.	1,200		
SUB TOTAL RS.					

BILL OF QUANTITIES  
PLUMBING WORK





**REVAMPING OF EXISTING PROVINCIAL ASSEMBLY BUILDING KARACHI**  
**(PACKAGE-II PHASE-II)**

**SUMMARY OF COST**

S.No	Activity	Amount (Rs.)
A	TOILET FITTING AND ACCESSORIES	
B	COLD WATER SUPPLY SYSTEM	
C	SOIL WASTE VENT AND RAIN WATER PIPE SYSTEM	
D	EXTERNAL SEWER SYSTEM	
	TOTAL RS.	

(Rupees \_\_\_\_\_ Only)

\_\_\_\_\_  
Signature & Seal of Contractor



**REVAMPING OF EXISTING PROVINCIAL ASSEMBLY BUILDING KARACHI  
(PACKAGE-II PHASE-II)**

**BILL OF QUANTITIES  
(PLUMBING & FIRE FIGHTING WORKS)**

S.No.	Description	Qty	Unit	Rate	Amount
<b>A</b>	<b>TOILET FITTING AND ACCESSORIES</b>				
1	Providing and fixing European type water closet with coupled flushing cistern, seat and cover (make: PORTA), including all accessories and fittings, waste and traps, CP flexible pipe, tee stop cock (Make: ZILVER) with check nuts, thimble, all joints to service and drains plugging and screwing as necessary to the structure.	20	Nos.		
2	Providing and fixing Asian type water closet with low Down flushing cistern (Make: PORTA), connecting pipe complete with all accessories and fittings waste and traps, flexible pipe, including tee stop cock (Make: ZILVER) with PVC rubber connector with check nuts, all joints plugging and screwing as necessary to the structure complete in all respect.	18	Nos.		
3	Providing and fixing wash basin with pedestal (Make: PORTA) with all accessories such as, tee stop cock with check nuts, CP flexible pipe, waste pipe, waste coupling (Make: ZILVER), bracket set, etc. Complete including bottle trap, Piller Cock (Make: ZILVER) and silicon sealant, all joint to service and drain, plugging and screwing as necessary to the structure.	40	Nos.		
4	Providing and fixing bathroom accessories including fixing with Rawal plug of approved quality complete in all respect.				
i	Liquied Soap dispenser "stain less steel". (Make:ZILVER)	10	Nos.		
ii	Towel rail, size 500mm x Dia 8 mm. (Make:ZILVER).	10	Nos.		
iii	Toilet paper holder, Stain less steel, Make:ZILVER).	24	Nos.		
iv	Cloth hook (double). Make:ZILVER>	6	Nos.		
v	Bibcock with Muslim shower.(Make: ZILVER).	24	Nos.		
vi	Bib cock Dia 0.50 Inches, for Janitor room.(MAKE: ZILVER).	5	Nos.		
vii	Bib cock Dia 0.75 Inches, for Green area watering.	10	Nos.		
				<b>Sub Total-A</b>	
<b>B</b>	<b>COLD WATER SUPPLY SYSTEM</b>				
1	Polypropylene Random co-polymer (PPRC) Piping for Cold Water pipes. Make: VESBO, DIZYAN (Turkey), Hydroplast (Germany). Providing, fixing, jointing, testing poly propylene Random co-polymer pipe as per BS 5174 or DIN 8077/78 including specials fittings such as socket, tees, elbows bends, reducer plug and union etc) supported on wall or buried in walls or suspended from roof slab as per specifications including colour tagging complete in all respect, providing sleeve in wall.				



S.No.	Description				Qty	Unit	Rate	Amount
	I	20	mm	Dia	1500	RFT		
	II	25	mm	Dia	1500	RFT		
	III	32	mm	Dia	750	RFT		
	IV	40	mm	Dia	600	RFT		
	V	50	mm	Dia	950	RFT		
2	Providing and construction of R.C.C. Valve chamber, inside size 18 inches x 18 inches, for dia 50 mm Gate valves, along with 18 inches x 18 inches Heavy duty water tight man hole frame and cover.				3	No.		deleted
3	Providing, Fixing of full way gate valves of bronze trim up to 3" (75 mm) Dia. With threaded ends and cast iron body bronze trim flanged ends for 4" O. (100 mm) and above for 125 psi together with all additional material required for a complete installation as described in the specification and as shown on drawings and as approved by the Engineer. (Make: VFNN, Japan, WATTS, USA, Rubinetterie Utensilerie BONOM, ITALY.							
	I	25	mm	Dia	12	Nos.		
	II	32	mm	Dia	6	Nos.		
	III	40	mm	Dia	6	Nos.		deleted
	IV	50	mm	Dia	6	Nos.		
4	Providing and installation of Pump controller and water level indicator system. The automatic pump control system shall be Solid state type, with Low voltage electrodes in the over head and underground water tanks with electronic controllers. The level sensor shall be adjustable for LOW/HIGH water levels in the tanks. Shall be installed in water proof boxes (IP 54). The pump controller shall start pump at low level in OHW tank and shut off at High level. LED will show different levels of water in underground water tanks. (Pakistan assembled with imported items)				2	Job		
							Sub-total B	
C	SOIL WASTE, VENT AND RAIN WATER PIPE SYSTEM							
1	Providing, Fixing in position UPVC pipes push fit type pipes for soil, waste water and rainwater system embedded in floor and wall or suspended from slab or clamped to floor and wall including plugs, clamps, hanger collars, supports, specials (bend, tees, Y-tee etc). Making requisite number of holes in walls and floors where required and making good the same as necessary to the structure labelling testing at 8 ft. (0.5 Bars) of water head. (Make: PALING, Malaysia, TERRAINE (SDP) Spain, HEPWORTH, UK/ DUBAI.							
	I	50	mm	Dia	250	RFT		
	II	75	mm	Dia	1,050	RFT		
	III	100	mm	Dia	1050	RFT		
2	Providing, Fixing UPVC cowl for vent pipe of the following including all accessories complete. (Make: PALING, Malaysia, TERRAINE (SDP) Spain, HEPWORTH, UK/ Dubai.							



S.No.	Description				Qty	Unit	Rate	Amount
	I	75	mm	Dia	12	Nos.		
	II	100	mm	Dia	12	Nos.		
3	Providing, Fixing Upvc floor drain / Floor Gully of approved design with UPVC grating including requisite number of holes in wall plinth or floor for pipe connection and making good the same the same as necessary to the structure complete including gasket and clamp complete. (Make: PALING, Malaysia, TERRAINE (SDP) Spain, HEPWORTH, UK/ Dubai.				85	Nos.		
4	Providing, Fixing UPVC clean out with cover making requisite number of holes in walls, plinth or floor for pipe connection and making good the same as necessary to the structure complete including, rubber gasket and clamp.							
	I	75	mm	Dia	12	Nos.		
	II	100	mm	Dia	12	Nos.		
5	Providing, Fixing (PVC. clean out Plug for pipe, making good the same as necessary to the structure complete including, rubber gasket and clamp.							
	I	75	mm	Dia	12	Nos.		
	II	100	mm	Dia	12	Nos.		
5	Providing, Fixing of Upvc Roof drain with domical grating, Similar to Model No. 871.110, Make "TERRAIN SDP" or EQ.							
	I	100	mm	Dia	6	Nos.		
							Sub Total C	
D	EXTERNAL SEWER SYSTEM							
1	Providing, laying and jointing PVC class-B, sewer pipe Conforming to BS-4515, DIN 19650, including excavation backfilling, compaction bedding, lowering in Trenches to correct alignment and grade, jointing, cutting pipes where necessary, inishing and testing complete as per drawing and specification. Make: PALING, Malaysia, TERRAINE (SDP) Spain, HEPWORTH, UK/Dubai.							
	I	150	mm	Dia	75	RFT		
2	Providing and construction of Gully Trap with 100 mm. thick masonry walls, internal size300 x 300 mm. inside and outside 15mm thick puddlo plaster. Bottom of gully trap shall be 100mm thick 1:2:4, RCC pad with normal reinforcement.Trap shall be of Upvc 100 mm Dia with 50-75mm water seal. Cast iron frame and cover water tight quality. Size 350x350 mm, weight 10 kgs.				10	Nos.		
3	Providing and construction of Man hole chambers conforming to BS-556, Part-2, ( Concrete Manholes for Drainage purpose). Heavy duty,Type-1. (Internal size 600 x 600 mm. or 600 mm dia).				6	Nos.		
4	Providing and Fixing of Cast iron Manhole Frame and covers (Water tight quality)Manufactured by good quality cast iron < Grade-B, (Class-1, Conforming toBS 497. Make. ALPINE, JAWS, Lahore-Pakistan.				6	Nos.		
							Sub Total-D	
							Grand Total Rs.	

BILL OF QUANTITIES  
ELECTRICAL WORK