



Consultant Company LTD

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## WORK SPECIFICATION

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### Project:

CONSTRUCTION OF WOMEN PERMANENT PRODUCTION EXHIBITION & CROSS-BORDER  
TRADE CENTER, ISLAM QALA BORDER, HERAT-AFGHANISTAN

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# CONSTRUCTION OF WOMEN TRADE CENTER, ISLAM QALA BORDER, HERAT-AFG.

## **Section-01 GENERAL PROVISION**

The Contractor shall complete work necessary to finish according to the contract and good construction standard and norms.

## **Section-02 SURFACES AND SUBSURFACE WORK**

### **2.1 SITE PREPARATION**

Before starting the work, it's recommended to ensure that the area is clear from UXO and mines. Certificates From authorized agency (UNMACA) will be taken and then clear the area from debris, wastes etc.

#### **2.1.1 Protection**

The contractor shall protect bench marks, survey control points, existing structures, existing trees, vegetation, landscaping materials, utilities and site improvements not scheduled for clearing which might be damaged by construction activities. The Contractor shall provide temporary protection of adjacent property, structures, benchmarks, and monument, and protected existing utility lines that are indicated to remain from damage.

#### **2.1.2 Clearing and Grubbing**

The Contractor shall clear and grub stumps, vegetation, surface rock, rubbish, designated trees, and site Improvements required for access to site and execution of work down to 50 cm for roots and other debris larger than 5 cm in diameter. Depression made by grubbing shall be filled with suitable material and Compacted to mark the surface confirm to the original adjacent surface of the ground.

### **2.2 EARTHWORK**

#### **2.2.1 Rough Grading and Leveling**

Grade and level the site as necessary to establish finished floor elevation, Level the grade to slope away from the finished grade around the building structures.

#### **2.2.2 Excavation**

Excavation for buildings, site improvements, and utilities as indicated on drawings. Unsatisfactory material encountered below the grades shown shall be removed as directed. Unsatisfactory material removed below the depths indicated shall be replaced with satisfactory materials to the indicated excavation grade.

#### **2.2.3 Backfilling and Compaction**

Drainage fill and backfill with clean river aggregate mix with sand for slabs, pavements, and improvements as shown on drawings, systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, spongy, or frozen material sub-grade surfaces.

#### **2.2.4 Rock**

Excavation without blasting unless authorized.

#### **2.2.5 Removal of Material**

Provide legal disposal of excavated materials.

#### **2.2.6 Finish Grading**

Provide all necessary finish grading over the entire site sloped away from the buildings.

## **2.2.7 Compaction**

The Contractor shall compact at 95 percent maximum density under structures, building slabs, steps, pavements, sloped ramps and walkways and 90% for general area. Compaction shall be accomplished by sheep foot rollers, vibratory compactors, or other approved equipment. Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, abbreviated as percent laboratory maximum density or some other equivalent and approved testing procedure. Required moisture range is plus or minus 2 percent of optimum moisture content.

## **2.2.8 Grading Tolerances Outside Building Lines**

The grading tolerance for fill under building slabs and foundations shall be plus or minus 12.5 mm measured with a 3-meter straightedge. The degree of finish for other graded areas shall be within 30 mm of the grades and elevations shown in the drawings. Slope away from buildings with gradual grade changes blending slope in to level areas.

## **2.2.9 Backfill and Fill Materials**

The backfill and fill material shall be clean soil materials, gravel and sand free of clay, rock or gravel not larger than 50 mm in any dimension, debris, waste, vegetation, and other unsuitable materials are prohibited.

## **2.2.10 Testing**

2.2.10.1 Testing shall have performed by an approved commercial testing laboratory or may be performed by the contractor subject to approval. Before start of work, adequate number of tests shall be made for each proposed type material, mix design, cement test, tensile strength test for steel bars etc.

## **2.2.11 General**

The design of the water and sanitary systems is sized to provide flow and discharge based on a fixture unit basis. The design drawings are showing all utility lines, line sizes, valves, manholes, and applicable details associated with water and sanitary system designs. Contractor shall install and connect exterior sanitary sewer collection and water supply piping to service connection points of each facility.

## **2.3 EXCAVATION, TRENCHING, AND BACKFILLING**

### **2.3.1 Excavation**

During satisfactory excavation, material for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to ½ the depth of the excavation, but in no instance closer than 600mm. Trench walls more than 1.3 meters high shall be shored cut back to a stable slope or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Stones of 75 millimeters or greater in any dimension shall be removed from the bottom of trenches to avoid point bearing.

### **2.3.2 Bedding and initial Backfill**

The contractor shall use granular material consisting of well-graded sand, river aggregate mix with sand, containing not more than 10 percent by weight passing a 0.075 mm mesh sieve and no less than 95 percent by weight passing the 25-mm sieve. The maximum allowable aggregate size shall be 38 millimeters, or the maximum size recommended, whichever is smaller.

### **2.3.3 Backfilling and Compaction**

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm loose thickness for compaction by hand

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operated machine compactors, and 200 mm loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for all soils, unless otherwise specified.

## **2.4 CONCRETE PAVEMENTS**

Concrete shall conform to the applicable requirements of section CAST IN PLACE CONCRETE, and as Specified herein.

### **2.4.1 Forms**

Use steel, wood or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal may be used. Use straight forms free of distortion and defects, extending the full depth of the concrete. Use flexible spring steel; forms or laminated boards to form radius bend as required. Coat forms with form release agent which will be discolor or deface of the concrete.

### **2.4.2 Joints**

Expansion and construction joints shall be placed as shows on drawings. Construction joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line.

For expansion joints, provide asphalt impregnated fiberboard and sealing compound. The expansion joint material shall conform to the manufacturer's recommendations for the application.

### **2.4.3 Concrete Placement**

Do not place concrete until base and forms have been checked for line and grade. Moisten sub grade to provide uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they have been set the required finish elevation and alignment. Perform concrete finishing using machine or hand methods as required.

### **2.4.4 Concrete Curing**

Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at the relatively constant temperature for a period of time necessary for hydration of cement and proper hardening.

### **2.4.5 Weather Limitations**

Construction shall be done when the atmospheric temperature is above 5 degrees C. When the temperature falls below 5 degrees C the contractor shall protect all complete areas by approved methods against disadvantageous effects of freezing. Complete areas damaged by freezing rainfall or other weather conditions shall be corrected to meet specified requirements.

### **2.4.6 Plant, equipment and tools**

All plant, equipment, and tools in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times.

The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness requirements.

**2.4.7 Material**

The ABC (AGGREGATE BASE COURSE) shall consist of clean, sound, durable particles of stone, river aggregate, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings.

The portion retained on the 4.75 mm sieve shall be known as coarse aggregate; that passing the 4.75 mm sieve shall be known as fine aggregate.

2.4.7.1 Coarse Aggregate: Coarse aggregates shall be angular particles of uniform density. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest mid sectional area of the piece.

2.4.7.2 Fine Aggregate: Fine aggregate shall be angular particles of uniform density and shall consist of screenings, angular sand, graveled recycled concrete fines or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.4.7.3 Gradation requirements

The specified gradation requirements shall have a maximum size of 38 mm and shall be continuously well graded within the limits specified in TABLE 1.

**TABLE 1. GRADATION OF AGGREGATES**

Percentage by Weight Passing Square-Mesh Sieve

50.0 mm	100	----
37.5 mm	95-100	----
25.0 mm	85-100	90-100
19.0 mm	70-90	70-90
12.0 mm	45-75	40-70
4.75 mm	20-50	20-50
2.00 mm	15-40	15-40
0.425 mm	5-25	10-25
0.075 mm	0-10	5-10

NOTE 1: Particles having diameter less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity.

## Section-03 CONCRETE

### 3.1 CAST IN PLACE CONCRETE

The work specified in this section consists of the construction of all concrete structures members and requirements for concrete mixes and testing of concrete mixes. This work shall include the construction of footings, floor slabs, and pedestal columns.

#### 3.1.1 Submittals

Each consignment of cement shall be accompanied by a manufacture's certificate showing that the cement has been tested and analyzed by an independent Testing Laboratory, and the date of such tests and analyses.

Submit test results of a concrete compression machine which must have a minimum compressive strength test result of 28 Mpa after 28 days.

#### 3.1.2 Delivery, Storage and Handling

Materials shall be inspected upon delivery for damage. Cement shall be stored in a watertight and well-ventilated building with a raised platform not less than 300 mm off the ground. Each consignment of cement shall be identified and stored separately.

#### 3.1.3 Floor concrete PCC ( $f'c$ : 150 kg/cm<sup>2</sup>)

All The concrete for floor shall be 10cm thick and 3cm PCC finishing for final floor surface. The strength used in floor concrete shall be 150kg/cm<sup>2</sup> and mixes of (1:2:4)

#### 3.1.4 Cement

Type: Utilize Portland cement, Type 1, ASTM C-150 or equivalent standard.

#### 3.1.5 General Aggregate

3.1.5.1 Aggregates shall be clean from dust and soil, and neutral sand, On no account shall naturally occurring boulder, shattered rock or weathered rock be used, Rock which from flat or flaky particles when crushed or which contains excessive quantities of mica or laminated materials shall not be used. The rock shall be free from all chemical substance likely to react in a harmful manner with other constituents of the concrete.

3.1.5.2 Sand shall be washed to remove traces of salt or other impurities and shall be formed of sound, clean and durable particles free from hollow shall discoloration clay, silt, organic, impurities or other deleterious substance.

3.1.5.3 The nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

#### 3.1.6 Formwork

Plywood or metal panel formwork shall be mortar tight and shall be sufficient for straight perpendicular structural and visual requirements. Do not use weak formwork that causes bulges gapes or holes in the poured concrete Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and all of other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a none staining

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bond breaker. Except as otherwise shown external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

### 3.1.7 Expansion Joints

For expansion joints, provide asphalt impregnated fiberboard and sealing compound. The expansion joint material shall conform to the manufacture's recommendations for the application.

### 3.1.8 Concrete Mixing

3.1.8.1 General mixing for other than structural building members will be with ratio of 1:1:2 (M: 280).

Maximum water-cement ratio (w/c) by weight shall be 0.45-0.50

3.1.8.2 Concrete mixing for structural building members shall be according to mix design tested to show 280 kg/cm (4000psi) the strength of the concrete will be considered satisfactory if the average of the all sets of three consecutive test results equals or exceeds the specified compressive strength and no individual test result falls bellow the specified strength by more than 3.5 MPa. Slump of the concrete for the structural building members, as delivered to the point of placement into the forms, shall be within 25 mm to 100 mm in accordance with ASTM C 143/C 143M or equivalent approved standards.

3.1.8.3 All concrete shall be power machine mixed and machine vibrated. About 10 percent of the water required for the batch shall enter the drum in advance of the cement and aggregates, and the remainder of the water shall be added gradually while the drum is in action so that all the water is in the drum by the end of the first quarter of the mixing time, the concrete shall be mixed until a mixture of uniform color and consistency is obtained.

3.1.8.4 The amount of concrete mixed in any one batch shall not exceed the rated capacity of the mixer. The whole of the batch shall be removed before materials for a fresh batch enter the drum. On cassation of work, including all stoppages exceeding 1 hour, the mixers and all handling plant shall be washed with clean water. Concrete mixed as specified above shall not be modified by the addition of the water or in any other manner to facilitate handling or for any other reason.

### 3.1.9 Concrete Placing

3.1.9.1 Before any concrete is placed the formwork shall be thoroughly cleaned of all dirt, shavings, loose stones, and other debris. Forms shall be treated with a non-staining material or shall be saturated with water immediately before the concrete is placed.

3.1.9.2 Immediately after mixing, the concrete shall be transported to the place of final deposit by methods which will prevent the separation, loss or contamination of any of the ingredients.

3.1.9.3 The concrete shall be placed gently in position and shall normally not have a free fall of more than 1.5 meter. The concrete shall be placed so as to prevent water from collecting at the ends, corners of along the faces of the forms, and water shall not be placed in large quantities at a given point and allowed to run or be worked over along distance in the form.



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3.1.9.4 All concrete shall be placed and compacted in even layers with each batch adjoining the previous one. The thickness of the layers shall be between 15 and 30 cm for reinforced concrete and up to 45 cm for unreinforced concrete.

3.1.9.5 The concrete shall be carefully and continually compacted and worked around the reinforcement steel and into the corners of the formwork so that the concrete shall be in close contact with the reinforcement steel and free from honeycombing. All vibration compaction and finishing operations shall be completed immediately after the placing of concrete in its final position.

3.1.9.6: Concreting in any one part or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed.

3.1.9.7 Freshly placed concrete shall be adequately protected from rain. Dust storms chemical attack and the harmful effects of sun, heat, wind, flowing water, vibrations and shocks.

#	Air Temperature	Size of the Concrete Section e.g depth of slab			
				300-900 mm < 300 mm Applies Applies Mainly Mainly for For slabs  Footings	900-1800  > 1800 mm
Final Placed Minimum Concrete Temperature					
1	-	13 C 10 C	70 C	5 C	
As Mixed Minimum Concrete Temperature for Indicated Air Temperature					
2	Above – 1 C	16 C 13 C	10 C	7 C	
3	- 18 to 1C	18 C 16 C	13 C	10 C	
4	Below - 18 C	21 C 18 C	16 C	13 C	
Max Concrete Temp. Drop in first 24 hours after end of Protection					
5	-	28 C 22 C	17 C	11 C	

## **3.1.10 Weather Precautions**

The temperature of the concrete as delivered shall be between 12 and 32 degrees C. Proper planning and approval should be obtained to concrete under weather conditions that are expected to cause placed concrete temperature to be outside the recommended limits. The following are the recommended concrete temperatures as per ACI 306R-88 for cold weather concreting:

## **3.1.11 Concrete Curing and Form Removal**

3.1.11.1 Concrete shall be protected during the first stage of hardening from the harmful effects of sunshine, drying winds, rain or running water. The protection shall be applied as soon as practicable after completion of placing by covering concrete with a layer of sacking, canvass, Hessian, straw mat or similar absorbent material or a layer of sand kept constantly wet for 7 days.

3.1.11.2 When the daily ambient low temperature is less than 0 degrees C the temperature of the concrete shall be maintained above 5 degrees C for the first seven days after placing. During the period of protection removal the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 13 degrees C.

3.1.11.3 Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Form work for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from removal operation but not before at least 24 hours has elapsed since concrete placement.

3.1.11.4 Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods.

## **3.1.12 Concrete Finishing**

3.1.12.1 All concrete shall be given an ordinary clean surface finish. Immediately following the removal of forms, all fines and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced from by form ties and all other holes honeycomb spots, broken corners or edges and other defects shall be thoroughly cleaned and after having been kept saturated with water for a period of not less than three hours shall be carefully pointed and trued with a mortar of cement and fine sand. The resulting surfaces shall be smooth, true and uniform in shape and uniform in color.

## **3.1.13 Testing**

The contractor shall perform the tests described below and shall take the action required.

### **3.1.13.1 Slump Testing**

At least two slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M or ACI 211.1-91 or approved equivalent standards for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. When a single slump test reaches or goes beyond either the upper or lower action limit a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the record slump of the batch and for determining need for any remedial

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action. Whenever slump reaches the upper action limit an adjustment shall immediately be made in the batch weights of water and fine aggregate.

Remedial action: Whenever slump reaches the upper action limit an adjustment shall immediately be made in the batch weights of water and fine aggregate.

**Table 6.3.1 – Recommended slumps for various types of construction\***

Types of construction	Slump, in.	
	Maximum <sup>+</sup>	Minimum
Reinforced foundation walls and footings	3	1
Plain footings, caissons, and substructure walls	3	1
Beams and reinforced walls	4	1
Building columns	4	1
Pavements and slabs	3	1
Mass concrete	2	1

\*Slump may be increased when chemical admixtures are used, provided that the admixture-treated concrete has the same or lower water-cement or water-cementitious material ratio and does not exhibit segregation potential or excessive bleeding.

<sup>+</sup>May be increased 1 in. for methods of consolidation other than vibration.

## 3.1.13.1 Concrete Testing

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 or approved equivalent standards and tested in accordance with these specifications, as considered necessary. The contractor shall provide six concrete cylinder testing samples for each type of reinforced concrete cast in any single day.

## 3.2 REINFORCING STEEL

This subsection contains a description and the specification for the furnishing, bending, fabricating and placing of steel reinforcement of the type, size shape and grade required in accordance with the Drawings, as specified herein.

### 3.2.1 Material

All reinforcing steel bars shall be deformed billet steel and shall meet the requirements of Grade 60000psi.

Testing shall be performed to verify tensile yield. The contractor shall submit test results of reinforcement steel.

### 3.2.2 Handling and Placing Reinforcement

All reinforcement steel shall be protected as far as practicable from mechanical injury or surface deterioration, rusting or other causes from the time of shipment until it is placed.

Reinforcement steel stored at the site shall be laid on wood floors or sills suitably spaced so that no reinforcement steel shall be laid upon or come in contact with the ground. When the weather is rainy or exceptionally humid bars shall be stored under cover.

### 3.2.3 Reinforcement

3.2.3.1 Each reinforcement steel bar shall be cut and bend to the dimension specified on the drawings. All bars shall be bent cold. Splicing will not be permitted, except where indicated on the drawings. Lap lengths shall be as indicated on the Drawings or according to approved standards.

3.2.3.2 The reinforcement steel shall be assembled to the shapes and dimension as indicated on the drawings. The rods shall be of the cross-sectional areas indicated and shall be fixed rigidly and accurately in the forms in the positions indicated on the drawings.

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3.2.3.3 The rods shall be firmly bound to gather at intersections of rods to ensure that the reinforcement steel framework as a whole shall retain its shape, and the framework shall be so temporarily supported as to retain its correct position in the forms during the process of depositing and consolidating the concrete.

3.2.3.4 The end of all tying wires shall be turned in to the main body of the concrete and not allowed to project towards the surface. No temporary metal supports to the reinforcement steel will be allowed and metal clips or supports shall not be placed in concrete with forms for exposed surfaces.

3.2.3.5 At the time of concreting, all reinforcement steel shall have been thoroughly cleaned and freed from all loose rust, scale, mud, oil or any other coatings that might destroyed or reduce the bond and it shall also have been cleaned of all set or partially set concrete which may have been deposited thereon during the placing of a previous lift of concrete.

3.2.3.6 The placing of all reinforcement steel bars will be checked by the CQC Manager and in no case, is concrete to be placed around any reinforcement steel that has not been approved by the CQC Manager.

3.2.3.7 The insertion of bars into or the removal of bars from concrete already placed will not be permitted.

3.2.3.8 Reinforcement steel temporarily left projecting from the concrete at the joins shall not be bent without the prior approval of the CQC Manager.

3.2.3.9 All reinforcement steel shall have a clear coverage as indicated on the drawings.

### **3.3 PLACE ARCHITECTURAL CONCRETE**

#### **3.3.1 GENERAL REQUIREMENT**

All materials, procedures, and requirements specified in Section 03 31 00.00 10 CAST-IN-PLACE STRUCTURAL CONCRETE shall fully apply to cast-in-place architectural concrete, except as otherwise specified.

##### **3.3.1.1 Design Requirements**

Concrete Mix: If it is determined that the concrete mix requires plasticizers, the requirements will be added in this paragraph. Slumps for plasticized concrete may range as high as 250 mm (10 inches).

The concrete mix shall be designed in accordance with ACI 210.1 and ACI 210.2. The mix design shall include consideration of the finishes required.

##### **3.3.1.2 Formwork Design**

Formwork design shall conform to ACI 301 and ACI 347R

##### **3.3.1.3 Detail Drawings.**

The Contractor shall submit detail drawings conforming to ACI SP-66 and ACI 318M/318RM ACI 318/318R. Detail drawings shall show location of cast-in-place elements in the work, building elevations, formwork fabrication details, reinforcements, embedment, dimensions, concrete strength, interface with adjacent materials, and special placing instructions, in sufficient detail to cover fabrication, placement, stripping, and finishing.

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## **3.3.1.4 Panels**

Sample panels shall be located as directed, shall be 1.8 m 6 feet long and 1.2 m 4 feet high with the thickness to match building conditions for each type of architectural concrete and finish. Panel forms shall include a typical joint between form panels, form tie conditions and finishes. Panels shall be protected from weather and other damage until acceptance of work. Sample panels shall be used as job standards throughout construction.

## **3.3.2 PRODUCTS**

### **3.3.2.1 MATERIALS**

Aggregates shall be crashed stone aggregate, clean and empty of dust and extra materials.

#### **3.3.2.1.1 Reinforcing Steel**

Reinforcing steel shall be galvanized and the clear cover to an exterior face is 25 mm 1 inch or less.

#### **3.3.2.1.2 Tie Wire**

Tie wire shall be soft model or 18-8 stainless steel.

#### **3.3.2.1.3 Plates, Angles, Anchors, and Embedment**

Plates, angles, anchors, and embedment shall conform to ASTM A36/A 36M, and shall be prime painted with inorganic zinc primer.

#### **3.3.2.1.4 Formwork: Formwork for special effects shall be as approved.**

#### **3.3.2.1.5 Form Release Agents**

Form release agents shall be manufacturer's standard, none staining, and none petroleum based, compatible with surface sealer finish coating.

#### **3.3.2.1.6 Surface Sealer Surface**

Sealer shall be methyl methacrylate polymer acrylic emulsion, clear color.

## **3.3.3 EXECUTIONS**

### **3.3.3.1 Form work erection**

Formwork shall be erected in accordance with the detail drawings to ensure that the finished concrete members conform accurately to the indicated dimensions, lines, elevations, and finishes. Deflection shall not exceed 1/360th of each component span or distance between adjacent supports. Deflections and tolerance shall not be cumulative. Form lines shall be installed as necessary to provide the required finish.

Forms shall be coated with form release agents before reinforcement is placed. Formwork shall conform to ACI 301 and ACI 347

### **3.3.3.2 Concrete finishes**

Concrete finishes shall conform to the approved finishes. Finishing shall be accomplished at the time of concrete placement or immediately after formwork removal, as follows:

#### **a. Smooth finish:**

(1) As cast using flat smooth nonporous forms.

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(2) As cast using fluted, sculptured, board finish or textured form liners.

b. Textured finish:

(1) Textured form liners applied to inside of forms.

(2) Distress finish by breaking off portion of face of raised portion of unit.

c. Exposed aggregate finish

(1) Finish obtained by applying even coat of retardant to face of form, removing forms after concrete hardens, and exposing coarse aggregate to a depth of 5 mm by washing and brushing or lightly sandblasting away surface mortar.

(2) Finish obtained by treating surface of unit with brushes which have been immersed in acid solution.

Cast-in-place concrete elements which are to have a finish other than the surface produced from standard formwork shall be accomplished by using the following procedures:

### 3.3.3.3 Joint Sealing

Joint sealing shall be as specified in Section, JOINT SEALANTS.

### 3.3.3.4 Cleaning

No sooner than 72 hours after joints are sealed, faces and other exposed surfaces of cast-in-place concrete shall be washed down, cleaned with soap and water applied with a soft bristle brush, then washed down again with clean water, or by other approved procedures. Discolorations which cannot be removed by these procedures shall be considered defective work. Cleaning work shall be done when temperature and humidity conditions are such that surfaces dry rapidly. Care shall be taken during cleaning operations to protect adjacent surfaces from damage.

### 3.3.3.5 Surface Sealing

After cleaning, exterior exposed architectural concrete surfaces indicated shall be given one coat of surface sealer, spray applied unless otherwise approved. Adjacent surfaces shall be protected to prevent damage from the surface sealer.

### 3.3.3.6 Protection of Work

Work shall be protected against damage from subsequent operations.

### 3.3.3.7 Defective Work

Defective work shall be repaired or replaced, as directed, using approved procedures.

## Section-04 Burned Brick Masonry works

**4.1 Exterior Walls:** The exterior walls will be constructed of Burned brick measuring as close to 7 cm height x 10 cm width x 20 cm length as possible, finished in Portland Cement-based plaster on exterior and gypsum works on interior layer. The walls will be constructed from the finished floor (top of slab) to ceiling according to drawings and details.

**4.2 Interior Walls:** The interior walls will be constructed of Burned brick measuring as close to 7 cm height x 10 cm width x 20 cm length as possible, finished in gypsum works on both faces. The walls will be constructed from the finished floor (top of slab) to ceiling according to drawings and details.

## Section-05 DOOR AND WINDOWS

### 5.1: STEEL and PVC DOORS

Provide the best quality of metal and PVC recommended by the door manufacturer and application of required finish.

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 100 mm( 4 inch) thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Replace defective or damaged doors with new ones .

**5-1-1: Hardware:** Provide the manufacturer's standard hardware fabricated from stainless steel, or other corrosion resistant material compatible with wood and of sufficient strength to perform the function for which it is intended.

**5-1-2: Fabrication:** Provide PVC doors with factory finish in all buildings to fit the masonry openings. Door openings shall be provided with insect screening permanently fixed to the exterior. Provide a locking device on the interior of each Door. Provide anchors on each side of the frame into the adjoining masonry, 3 on each side. Provide weather stripping system for all exterior windows and doors.

**5-1-3: Finishes:** Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.

Color: Selections by Contracting Officer

**5-1-4: Inspection:** Inspect openings before beginning installation. Verify that rough or masonry opening is correct and the sill plate is level.

**5-1-5: Installation:** Comply with manufacturer's specifications and recommendations for installation of door units, hardware, operators, and other components of the work. Set door units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place. Set sill members and other members in a bed of compound or with joint fillers or gaskets, as shown, to provide weather tight construction. Refer to the Sealant sections for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the work.

**5-1-6: Adjusting:** Adjust operating sash and hardware to provide a tight fit at contact points and at weather stripping for smooth operation and a weather tight closure.

**5-1-7: Cleaning:** Clean aluminum surfaces promptly after installation of door. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances. Lubricate hardware and other moving parts.

### 5-2: STEEL and PVC WINDOWS

Provide alloy and temper recommended by the window manufacturer for the strength, corrosion resistance, and application of required finish

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Fasteners: Provide nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.

1. Reinforcement: Where fasteners screw-anchor into steel less than 0.125 inch thick, reinforce the interior with nonmagnetic stainless steel to receive screw threads or provide standard noncorrosive pressed-in splinted grommet nuts.

2. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match the finish of the member or hardware being fastened, as appropriate.

Anchors, Clips, and Window Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel or iron complying with the requirements of DIN 1748; provide sufficient strength to withstand design pressure indicated. As a minimum provide 3 anchors on each side of the frame.

Compression-Type Glazing Strips and Weather stripping: Unless otherwise indicated, and at the manufacturer's option, provide compressible stripping for glazing and weather stripping such as molded EPDM or neoprene gaskets.

Sealant: For sealants required within fabricated window units, provide type recommended by the manufacturer for joint size and movement. Sealant shall remain permanently elastic non-shrinking, and no migrating.

Comply with Sealants of these specifications for selection and installation of sealants.

Wire Fabric Insect Screen shall be permanently fixed to the exterior.

## **5-2-1: Hardware**

Provide the manufacturer's standard hardware fabricated from stainless steel, or other corrosion resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.

## **5-2-2: Fixed, Casement, Projected and Sliding Windows**

Provide window units meeting UL 752, level 5, but no less than 16 mm laminated single glazed. This standard shall apply to all window units within guard shack, guard house, guard tower, and guard rooms in headquarters Building.

## **5-2-3: Fabrication**

Provide metal and PVC windows with factory finish in all buildings to fit the masonry openings. Window openings shall be provided with insect screening permanently fixed to the exterior. Provide a locking device on the interior of each window. Provide anchors on each side of the frame into the adjoining masonry, 3 on each side. Provide weather stripping system for all exterior windows and doors.

## **4-2-4: Finishes**

Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.

Color: Selections by Contracting Officer



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## **5-2-5: Inspection**

Inspect openings before beginning installation. Verify that rough or masonry opening is correct and the sill plate is level. Masonry surfaces shall be visibly dry and free of excess mortar, sand, and other construction debris.

## **5-2-6: Installation**

Comply with manufacturer's specifications and recommendations for installation of window units, hardware, operators, and other components of the work. Set window units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place. Set sill members and other members in a bed of compound or with joint fillers or gaskets, as shown, to provide weather tight construction. Refer to the Sealant sections for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the work.

## **5-2-7: Adjusting**

Adjust operating sash and hardware to provide a tight fit at contact points and at weather stripping for smooth operation and a weather tight closure.

## **5-2-8: Cleaning**

Clean aluminum surfaces promptly after installation of windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances.

Lubricate hardware and other moving parts.

## **Section-6: GLAZING**

### **MATERIAL**

Clear wired double glass, each 4 mm thick shall be installed in all doors and windows vision panels.

## **Section-7 Finishing**

**7-1:** Contractor should submit to the client a color and fabric chart for all materials and finishing so the client approves the accepted so the client approves the accepted color and fabric.

## **Section-8: PAINTING**

Supply first line commercial quality products for all coating systems. Prepare surfaces to be completely clean and free from any dirt, rough edges or improper material of any kind in order that the paint will adhere firmly.

### **8.1 Exterior Paint Schedule**

8.1.1 Extreme outside walls, will be painted onto the clean PEB MEMBER with:

- A. 1 (one) coat of flat exterior latex undercoat;
- B. 2 (two) coats of flat exterior latex paint, white color or any light color approved by the contracting officer.

8.1.2 Doors exterior and interior will be painted onto clean metal surfaces, including door fame, with:

- a) 1 (One) coat of enamel rust-proof undercoat;
- b) 2 (Two) coat of semi- gloss exterior enamel paint, white color or any light color approved by the contracting officer.

### **8.2 Interior Painting Schedule**

8.2.1 All interior walls, will be painted onto the clean surface:

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- a) 1 (One) coat of flat interior latex undercoat;
- b) 2 (Two) coats of flat exterior latex paint, white color or any light color approved by the contracting officer.
- c) The end wall in each room will be painted with:  
1 (one) coat of flat interior latex undercoat, and 2 (two) coats of flat latex paint, white color or any light color approved by the contracting officer.

## **Section - 9 STRUCTURAL SPECIFICATIONS**

### **9.1: REINFORCED CEMENT CONCRETE (RCC) STRUCTURE, COLUMNS AND CEILING**

9.1.1 This building has been designed to support its own dead load plus all other anticipated loads.

9.1.2 **Design Codes and software:** The international codes used for the design of the building structure are but not limited to: ACI Code 318-14, AISC 14, AISC 360-16, ASCE-7-10, Afghanistan Building Code (ABC), International Building Code (IBC), the software used for the design of structure is ETABS 2017, and for the foundation CSI SAFE 12 and Micro Soft Excel.

## **Section-10-MECHANICAL**

### **10.1 Execution**

Clean all debris, dirt, gravel, etc, from inside of piping before placing valves in place. Erect and support valves in respective positions free from distortion and strain. Install all materials per manufacturer's installation instructions. Test operating mechanisms to check proper functioning, and check nuts and bolts for tightness. Set plumb and support valves adequately in conformance with instructions of manufacturer. Shim valves mounted on face of concrete vertically and grout in place.

## **Section-11: ELECTRICAL**

### **11.1 MATERIALS AND EQUIPMENT**

All materials and equipment shall be new with no defects that are supplied and installed. All materials and equipment shall be noted on the Contractor's Submittal register. Equipment and material submittals shall contain all essential manufacturer's literature, specifications, reports, samples, tests, and or certifications as necessary to verify that the material and/or equipment meets specification requirements.

#### **11.1.2 EQUIPMENT AND MATERIAL GUARANTEES**

All materials and equipment furnished shall be guaranteed against defective materials and workmanship for a period agreed with the contractor.

#### **11.1.3 CODES, RULES, PERMITS AND FEES**

The contractor shall issue all necessary notices, obtain all permits and pay all government taxes, fees, and costs, including utility connections or extensions for all work associated with this specification section. The contractor shall file all necessary plans, prepare all documents and obtain all necessary approvals of all necessary jurisdictional government departments.

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## **11.1.4 GROUNDING**

11.1.4.1 Grounding electrode system shall be accomplished to obtain the low resistance allowable for the system.

11.1.4.2 Grounding electrodes shall be placed not less than 60 cm. away from exterior surfaces and foundations. Wherever possible, they shall not be placed under concrete slabs.

11.1.4.3 Grounding electrodes shall be driven to a depth, not less than 60 cm below the original ground surface.

11.1.4.4 All non-current carrying metal parts of the electrical system shall be grounded.

11.1.4.5 The grounding conductors shall be copper.

## **11.1.5 ACCEPTANCE TESTING**

11.1.5.1 All acceptance testing and testing procedures shall be incorporated in the contractors Quality Control Plan.

11.1.5.2 Acceptance testing shall, as a minimum, include testing for overall resistance of grounding electrode systems and the electrical continuity of all conductors and earth resistance.

## **11.2 CONDUIT AND CONDUIT WIRING SYSTEMS**

### **11.2.1 Description**

This specification Section describes general requirements associated with the supply, manufacture and installation of electrical wiring and cable conduit and conduit system. Other provisions of the specifications pertaining to electrical requirements and equipment shall be applicable as appropriate.

11.2.1.1 Conduit for different systems shall be kept separate and individual. Conduit provided for systems having different voltages shall be installed separately and individually, with the exception of the control circuits, of 220 VAC rated operating voltage, and low voltage power circuit which shall be permitted to occupy the same conduit system.

11.2.1.2 Conduit systems for different panel-boards, distribution boards, motor control centers and terminal cabinets shall be separate and individual.

11.2.1.3 Conduits smaller than 12mm electrical trade size shall not be used.

11.2.1.4 The number of branch circuits contained in a single conduit shall be no more than three.

### **11.2.2 ELECTRICAL METALLIC TUBING (EMT)**

11.2.2.1 Shall be permitted for exposed work inside buildings and for concealed work with concealment above ceilings, in concrete above ceilings, in concrete and masonry walls, concrete slab, and in columns.

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11.2.2.2 It shall not be used in wet locations, locations outside of buildings or where it may be subjected to physical damage.

### **11.2.3 Polyvinyl Chloride Conduit**

11.2.3.1 Shall be of UPVC type according to DIN requirements.

11.2.3.2 Shall be permitted for use with under plaster, underground grounding conductors, and lighting system grounding conductors.

11.2.3.3 Shall be permitted to serve as the ducting of duct banks.

### **11.2.4 ACCESSORIES**

11.2.4.1 Boxes shall be provided in the conduit and raceway systems for cable splicing, cable pulling, and the mounting of equipment and devices.

11.2.4.2 Pull Boxes for EMT conduits shall be galvanized and made of sheet steel not less than 1.6 mm in thickness. Pull boxes for UPVC conduits shall be UPVC type as per applicable Din requirements.

11.2.4.3 Junction boxes for EMT Conduits shall be standard-galvanized steel square outlet boxes, of 50mm. depth and not less than 1.20-mm thickness. Junction boxes for UPVC conduits shall be Adaptable UPVC square boxes as per applicable DIN requirements.

11.2.4.4 Outlet boxes for EMT conduits shall be standard-galvanized steel square outlet boxes, of 50mm depth and not less than 1.20 mm. thickness shall be provided for all luminaries, and for all surface mounted equipment and devices. Outlet boxes for UPVC conduits shall be UPVC gage boxes recessed in the wall.

### **11.2.5 THW Cables (MEA Type A)**

#### **11.2.5.1 Conductor**

- a) Shall be solid annealed copper conductor.
- b) Conductors with cross-sectional areas of 6sq.mm or more shall be Stranded conductors.

#### **11.2.5.2 Insulation**

- a) Polyvinyl chloride
- b) Maximum Conductor Temperature
- c) Not be less than 70 degree C.
- d) Rated Voltage
- e) Not be less than 750 VAC

#### **11.2.5.3 Applications**

- a) Runs in aboveground conduits, in wire ways, or on cable trays located inside buildings.
- b) Cable trays shall have cross-sectional areas not less than 50 sq.mm.

### **11.2.6 NYY Cables (MEA Type C)**

#### **11.2.6.1 Conductor**

- a) Shall be single conductor cable.
- b) Shall be solid annealed copper conductor
- c) Conductors with cross-sectional areas of 6.sq.mm or more shall be stranded conductors.

11.2.6.2 Insulation

- a) Polyvinyl chloride
- b) Sheath and Under Sheath
- c) Polyvinyl chloride.

11.2.6.3 Maximum Conductor Temperature

- a) Not be less than 70 degree C
- b) Rated Voltage
- c) Not be less than 750 VAC

11.2.6.4 Applications

- a) Underground runs in conduit
- b) On cable trays located inside buildings.

**11.2.7 PHASE IDENTIFICATION AND COLOR CODING**

Phase – A : yellow

Phase – B : Red

Phase – C : Blue

Phase – N : White

Ground : yellow and Green

**11.3 GROUNDING SYSTEMS**

11.3.1 Requirements

11.3.1.1 All non-Current carrying metal parts of equipment and materials of the electrical system and related systems shall be grounded.

11.3.1.2 The grounding conductors and grounded conductors shall be copper.

**11.3.2 GROUNDING ELECTRODE SYSTEMS**

Grounding electrodes shall be the solid copper rods having a diameter of not less than ½ inch and a length of not less than 10 feet.

**11.3.3 ACCEPTANCE TESTING**

11.3.3.1 All acceptances testing and testing procedures shall be incorporated in the Contractors Constriction Quality Control plan.

11.3.3.2 All testing reports shall be submitted to the Engineer in accordance with consented procedures and requirements of the plan.

11.3.3.3 Acceptance testing shall, as a minimum, shall include insulation resistance tests performed using a voltage of 500 V, prior to connecting low voltage cables of feeder and branch circuits to equipment.

## **11.3.4 Work Testing**

11.3.4.1 the electrical installation shall be fully tested and inspected to assure that all equipment, devices and wiring has been properly installed, that all components meet specified requirements and all components operate as intended.

11.3.4.2 The conduit system shall be fully tested and inspected to assure that its components have been properly installed and meet specified requirements.

11.3.4.3 Special attention shall be given to ensure requirements are adhered to with respect to weatherproof enclosures, sealed location and sealed pouring.

11.3.4.4 Conduit drains, supports, fitting covers and other components shall be checked and verified.

11.3.4.5 Insulation resistance tests shall be performed using a 5000-volt DC meager on a 400-volt system.

11.3.4.6 Insulation resistance shall not be less than on mega-ohm per 1,000-volt rating.

## **11.4 PANEL BOARDS**

Material and equipment shall be standard products of a manufacturer regularly engaged in their manufacture and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. All materials shall conform to the requirements of these specifications.

Materials shall be of high quality, free from defects and imperfections, of recent manufacture, and of the classification and grades designed.

### **11.4.1 Nameplates**

Nameplates shall be made of laminated sheet plastic or of anodized aluminum to provide white letters on a black background, the nameplates shall be fastened to the panels in proper positions.

### **11.4.2 Products**

All bolts, studs, machine screws, nuts, and tapped holes shall be in accordance with ASME B1.1 or equivalent DIN, I.E.C., BS, or EN standards. The sizes and threes of all conduit and fittings, tubing and fittings, and connecting equipment shall be in accordance with ASME B1.20.1 or equivalent DIN, I.E.C., BS, or EN standards.

### **11.4.3 Circuit Breakers**

Molded case circuit breakers shall conform to the applicable requirements of NEMA AB 1, UL 489, or DIN, IEC 60898-1 or BS EN 60947-2, standards. The circuit breakers shall be manually operated, shall be quick-make, quick-break, common trip type, and shall be of automatic-trip type unless otherwise specified or indicated on the drawings. All poles of each breaker shall be operated simultaneously by means of a common handle. The operating handles shall clearly indicate whether the breakers are in "On," "Off," or "Tripped" position and shall have provisions for padlocking in the "Off" position. Personnel safety line terminal shields shall be provided for each breaker. The circuit breakers shall be products of only one manufacturer, and shall be interchangeable when of the same frame size. Except as otherwise noted, the circuit breakers, of frame sizes and the trip unit ratings as shown on the drawings, shall be provided with combination thermal and instantaneous magnetic trip units. Nonadjustable instantaneous magnetic trip units shall be set at approximately 10 times the continuous current ratings of the circuit breakers.

## 11.4 Panel boards

11.4.1 Panel boards shall consist of assemblies of molded-case circuit breakers with buses and terminal lugs for the control and protection of branch circuits to motors, heating devices and other equipment operating at 380 volts ac or less. Panel boards shall be designed for installation in surface-mounted or flush –mounted cabinets accessible from the front only, as shown on the drawings.

11.4.2 Enclosures shall meet the requirements of UL 50, IEC 60529. All cabinets shall be fabricated from sheet steel. Cabinets mounted outdoors or flush-mounted shall be hot-dipped galvanized after fabrication.

11.4.3 All panel boards shall be of the dead-front type with buses and circuit breakers mounted on a plate or base for installation as a unit in a cabinet. All bus bar shall be of copper. Copper bars and shapes for bus bar conductors shall conform to the applicable requirements of ASTM B 187. The size of buse and the details of panel board construction shall meet or exceed the requirements of NEMA PB 1, or BSEN 609472.

11.4.4 Each branch circuit and the main bus bar where so specified or shown on the drawings, shall be equipped with molded-case circuit breakers having over current trip ratings as shown on the drawings. The circuit breakers shall be of a type designed for bolted connection to busses in a panel board assembly.

11.4.5 Provide starter as specified for stand-alone full voltage no reversing starter, and provide withnonfsd disconnect switch mounted in common enclosure. Providing operating handle for disconnect mechanism with indication of control switch position, with enclosure door either opened or closed.

11.4.6 Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than on coat of corrosion resisting paint in accordance with the manufacturer's standard practice.

Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semi gloss finish. Equipment located indoors shall be light gray, and equipment located outdoors shall be light grey or dark gray, or according to international building code requirements and ASTM standards.

All touch-up work shall be done with manufacturer's coatings as supplied under paragraph SPARE PARTS.

## 11.5 INTERIOR ELECTRICAL WORK

### 11.5.1 Grounding

Grounding shall be in conformance with NFPA 70, the contract drawings, BoQ, and the following specifications.

11.5.1.1 Ground Rods: the resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. the maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, 3 additional rods not less than 1.8 meters on centers may be coupled and driven with the first rod. Connections below grade shall be fusion welded. Connection above grade shall be fusion welded or shall use UL 467 approved.

11.5.1.2 Grounding bus bar shall be providing in the electrical equipment rooms as indicated. None current carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by

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boding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 100mm above the floor.

Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connections or bolted connections shall be used for connections to removable equipment. Connections shall be bolted type in lieu of thermo weld, so they can be changed as required by additions and/or alterations.

**11.5.1.3 Grounding conductors:** A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panel boards, the equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

### **11.5.2 Wiring Methods**

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc-coated steel conduit, rigid plastic conduit, electrical metallic tubing, or intermediate metal conduit. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified.

**11.5.2.1 Conduit and tubing systems** shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types. Minimum size of raceways shall be 15 mm. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or then required by conformance to NFPA 70. Nonmetallic conduit and tubing may be used in damp, wet or corrosive locations when permitted by NFPA 70 and the conduit or tubing system is provided with appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Electrical metallic tubing (EMT) may be installed only within buildings, EMT shall not install in damp or wet locations, or the air space of exterior masonry cavity walls.

**11.5.2.2 Pull Wires:** a pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 15 meters in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 45 meters in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 1.4 MPa (200psi) tensile strength., Not less than 254 mm of slack shall be left at each end of the pull wire.

**11.5.2.3 Conduit Stub-Ups:** where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 150 mm above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.



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11.5.2.4 Below Slab-on-Grade or in the Ground: Electrical wiring below slab-on-grade shall be protected by a conduit system.

11.5.2.5 Supports: Metallic conduits and tubing, and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 3 meters and within 900 mm of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze.

### **11.5.2.6 Cable Systems:**

Cable systems shall be installed where indicated. Cables shall be installed concealed behind ceiling or wall finish where practicable. Cables shall be threaded through holes bored on the approximate centerline.

Sleeves shall be provided through bond beams of masonry-block walls for threading cables through hollow spaces. Exposed nonmetallic-sheathed cables less than 1.2 meters above floors shall be protected from mechanical injury by installation in conduit or tubing.

### **11.5.3 Cable Splicing:**

Splicing shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

### **11.5.4 Conductor Identification and Tagging**

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made, where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

### **11.5.5 Boxes and Supports**

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate, except where minimum mounting heights for hazardous areas are required by NFPA 70. Unless otherwise indicated, boxes for wall switches shall be mounted 1.2 meters above finished floors.

### **11.5.6 Receptacles**

10.5.6.1 Single and Duplex, 15 or 20-ampere, 220 volt: Single and duplex receptacles shall be rated 20 amperes, 220 volts, two-pole, three-wire, grounding type with polarized parallel slots...

10.5.6.2 Water proof Applications: Waterproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeling to identify the allowable use.

10.5.6.3 Special-Purpose or Heavy-Duty Receptacles: Special-Purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose, contact surfaces may be either round or rectangle.

### **11.5.7 Wall Switches**

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type of the solder less pressure type having suitable conductor-released arrangement.

#### **11.5.8 Underground Services**

Unless otherwise indicated, interior conduit systems shall be stubbed out 1.5 m beyond the building wall and 600 mm below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits.

#### **11.5.9 Lighting Fixtures**

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

11.5.9.1 Lamps: lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the government if more than 15% of their rated life has been used.

11.5.9.2 Lighting Fixture: suspended fixtures shall be provided with swivel hangers or hand-strights so that they hang plumb. Pendants, rods, or chains 1.2 meters or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degrees of separation. Maximum distance between suspension points shall be 3.1 meters.

11.5.9.3 Emergency light Sets: Emergency light sets shall conform to UL 924 with the number of heads as indicated. Sets shall be permanently connected to the wiring system by conductors installed in short lengths of flexible conduit.

#### **11.5.10 Equipment Connections**

Flexible conduits 2 m or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

#### **11.5.11 Safety**

11.5.11.1 The contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The contractor shall replace any devices or equipments which are damaged due to improper test procedures or handling.

11.5.11.2 ground-Resistance Tests: The resistance of each grounding electrode shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry.

11.5.11.3 Conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

11.5.11.4 Cable Tests: An insulation resistance test shall be performed on all low and medium voltage cable after the cables are installed in their final configuration and prior to energizing. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of

conductors. The minimum value of resistance shall be:  $R \text{ in mega ohms} = (\text{rated voltage in kV} + 1) \times 304.8 / (\text{length of cable in meters})$

## **11.5.11.5 Medium Voltage Cable Tests**

- a) Continuity test.
- b) Insulation resistance test.
- c) AC or DC high-potential test.

## **11.5.11.6 Low Voltage Cable Tests**

- a) Continuity test.
- b) Insulation resistance test.

## **11.5.11.7 Metal Enclosed Bus Duct Tests**

- a) Insulation Resistance phase-to-phase, all combinations.
- b) Insulation resistance phase-to-ground, each phase.
- c) AC or DC high-potential test.
- d) Phase rotation test.

## **11.5.11.8 Circuit Breakers**

- a) Insulation resistance test phase-to-phase, all combinations.
- b) Insulation resistance test phase-to-ground, each phase
- c) Manual and electrical operation of the breaker

## **11.5.11.9. Automatic transfer switches and by pass/isolation switch**

Standard switch shall be provided to off single and double line power during starting and switching off one of the generator.

## **11.5.11.10 Surge Arresters**

Standard Surge Arresters shall be provided and installed to prevent firing and damages of appliances. The surge Arresters shall be capable of voltage rang of (180-220) Volts.

**11.5.11.11 Underground Electrical distribution** the main power cables distribution among the building shall be underground system. Interior conduit systems shall be stubbed out 1.5 m beyond the building wall and 600 mm below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits unless otherwise indicated.

**11.5.11.12 Seismic Protection for Equipment:** the contractor shall consider the same method of earth force prevention for all electrical appliances. All the building shall be is design for seismic protection of grade 8, including generator room; well house and etc. all the electric fixture will be fixed well tight to wall and frame.

## **A. BOLTS AND NUTS**

Square head and hex head bolts, and heavy hexagon nuts, ASME ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563MASTM A 563 for nuts ASTM A 325M ASTM A 325 for bolts and nuts]. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M

## **B. ANCHOR BOLTS**

Cast-In-Place Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. [One nut] [Two nuts] shall be provided on each bolt. Anchor bolts shall conform to ASTM A 307.

Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt.

Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

11.5.11.13 Main Electric supply station: Contractor shall install main supply system in underground cables according the load capacity for each building.

11.5.11.14 Switchboard: the contractor shall install switch board in each room according to the capacity of switches and outlets design.

### **11.5.12 Operating Test**

After the installation is completed, and at such as the contracting officer may direct, the contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements.

## **11.6 Lightning Protection System**

### **11.6.1 Materials**

BCF shall not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, BCF provides conductors with protective coatings or oversize conductors. Where mechanical hazard is involved, BCF increases conductor size to compensate for hazard or to protect conductors by covering them with molding or tubing made provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic).

#### **11.6.1.1 Main and Bonding Conductors**

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

#### **11.6.1.2 Copper**

Provide copper conductors on nonmetallic stacks that do not weigh less than 144.83 kg per 305 meters 319 pounds per thousand feet, and provide cable such that the size of any strand in the cable is not less than No. 15 AWG. Provide thickness of web or ribbon on stacks that is not less than No. 12 AWG. Provide loop conductors that are comprised of copper conductors not smaller than No. 1/0 AWG.

#### **11.6.1.3 Aluminum**

Do not allow aluminum to contact the earth and do not use in any other manner that will contribute to rapid deterioration of the metal. Observe appropriate precautions at connections with dissimilar metals in accordance with NFPA 70 Article 110-14. Provide aluminum cable conductors for bonding and interconnecting metallic bodies to main cable that are at least equivalent to strength cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, use strips that are much wider than solid strips. Use a strip width that is at least twice that of the diameter of the perforations. Use an aluminum strip which has a thickness of not less than the diameter of No. 12 AWG and at least 40 mm 1 1/2 inches wide for connecting exposed water pipes.

## **11.6.2 COMPONENTS**

### **11.6.2.1 Air Terminals**

Provide terminals in accordance with UL 96, except provide Class II for Class I and Class II applications.

Support air terminals more than 610 mm 24 inches in length by suitable brace, with guides, not less than one-half the height of the terminal.

### **11.6.2.2 Ground Rods**

Provide [ground rods made of [copper-clad steel] [stainless steel] [solid copper] conforming to conform to UL 467.] [Galvanized ferrous rods conforming to ANSI C135.30] Provide ground rods that are not less than 20 mm 3/4 inch in diameter and 3050 mm 10 feet in length. Do not mix ground rods of copper-clad steel, stainless steel, galvanized ferrous, or solid copper on the job.

### **11.6.2.3 Grounding Plates**

Provide grounding plates made of [copper-clad steel][iron][stainless steel] [solid copper] conforming to UL 96.

### **11.6.2.4 Connections and Terminations**

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

### **11.6.2.5 Connector Fittings**

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780.

### **11.6.2.6 Lightning Protection Components**

Provide bonding plates, air terminal supports, chimney bands, clips, and fasteners that conform to UL 96 classes as applicable.

## **11.6.3 EXECUTION**

### **11.6.3.1 INTEGRAL SYSTEM**

Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, grounding electrodes and ground loop conductor. Electrically interconnect lightning protection system to form the shortest distance to ground. Do not use non-conducting parts of the structure as part of the building's lightning protection system. Expose conductors on the structures except where conductors are required to be in protective sleeves. Interconnect secondary conductors with grounded metallic parts within the building. Make interconnections within side-flash distances at or above the level of the grounded metallic parts.

#### **11.6.3.1.1 Air Terminals**

Air terminal design and support conforming to NFPA 780. Rigidly connect terminals to, and make electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal. Provide pressure connector or crimped joint with a dowel or threaded fitting to connect ground rod conductor with air terminal. Set air terminals at ends of structures not more than 610 mm 2 feet from ends of ridges and corners of roofs. Do not exceed 7620 mm 25 feet in spacing of 610 mm 2-foot-high air terminals on ridges, parapets, and around perimeter of building with flat roofs. When necessary to exceed this spacing,

increase specified height of air terminals not less than 50 mm 2 inches for each 305 mm one foot of increase over 7620 mm 25 feet. On large flat, or gently sloping roofs, as defined in NFPA 780, place air terminals at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 15 m 50 feet in length. Secure air terminals against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces which are permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings such as smokestacks and other metal objects that are at least 3/16 inch 4.763 mm thick and that do not contain hazardous materials, need not be provided with air terminals. However, bond these metal objects to a lightning conductor through a metal conductor of the same unit weight per length as the main conductor.

Where metal ventilators are installed, mount air terminals thereon, where practical. Bond air terminals, erected by necessity adjacent to a metal ventilator, to the ventilator near the top and bottom.] Where on metallic spires, steeples, or ventilators are present, mount air terminals to the side. In addition, where spires or steeples project more than 3050 mm 10 feet above the building, continue conductor from air terminal to nearest down conductor securely connect thereto.

### **11.6.3.1.2 Roof Conductors**

Connect roof conductors directly to the roof or ridge roll. Avoid sharp bends or turns in conductors. Do not make turns of less than 205 mm 8 inches. Preserve horizontal or downward course on conductors.

Rigidly fasten conductors every 915 mm 3 feet along the roof and down the building to the ground. Rigidly connect metal ventilators to the roof conductor at three places. Make connections electrically continuous. Course roof conductors along contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Connect roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs to form a closed loop.

### **11.6.3.1.3 Down Conductors**

Make down conductors electrically continuous from air terminals and roof conductors to grounding electrodes. Course down conductors over outer extreme portions of the building, such as corners, with consideration given to location of ground connections and air terminals. Provide each building or structure not less than two down conductors located as widely separated as practicable, such as at diagonally opposite corners. [Rectangular structures having gable, hip, or gambrel roofs more than 33 m 110 feet long, provide at least one additional down conductor for each additional 15 m 50 feet of length or fraction thereof.] [Rectangular structures having French, flat, or saw tooth roofs exceeding 76 m 250 feet in perimeter, provide at least one additional down conductor for each 30 m 100 feet of perimeter or fraction thereof.] [Lor T-shaped structure, provide at least one additional down conductor.] [H-shaped structure, at least two additional down conductors.] [Wing built structure, at least one additional down conductor for each wing.] [Irregularly shaped structures provide enough conductors so that the average distance between them along the perimeter is not greater than 30 m 100 feet.] [Structures exceeding 15 m 50 feet in height, provide at least one additional down conductor for m 50 feet in height, provide at least one additional down conductor for each additional 18 m 60 feet of height or fraction thereof, except that this application will not cause down conductors to be placed about the perimeter of the structure at intervals of less than 15 m 50 feet.

Install additional down conductors when necessary to avoid "dead ends" or branch conductors exceeding 5 m 16 feet in length, ending at air terminals. Equally and symmetrically spaced down conductors about the perimeter of the structure. Protect conductors where necessary, to prevent physical damage or displacement to the conductor.

## **11.6.3.1.4 Interconnection of Metallic Parts**

Connect metal doors, windows, and gutters directly to ground or down conductors using not smaller than No. 6 copper conductor, or equivalent. Where there is probability of unusual wear, mechanical injury, or corrosion, provide conductors with greater electrical capacity than normal or protect the conductor. Provide mechanical ties or pressure connectors between grounds and metal doors and windows.

## **11.6.3.1.5 Ground Connections**

Securely connect conductor forming continuations of down conductors from structure to grounding electrode in a manner to ensure electrical continuity between the two. Provide clamp type connections or welds (including exothermic) for continuation. Provide a ground connection for each down conductor.

Attach down conductors to ground [rods] [plates] by welding (including exothermic), brazing, or clamping.

Provide clamps suitable for direct burial. Protect ground connection from mechanical injury. Bond metal water pipes and other large underground metallic objects together with all grounding mediums. In making ground connections, take advantage of all permanently moist places where practicable, although avoid such places when area is wet with waste water that contains chemical substances, especially those corrosive to metal.

## **11.6.3.1.6 Grounding Electrodes**

Provide grounding electrode for each down conductor. Extend driven ground rods into the existing undisturbed earth for a distance of not less than 3050 mm 10 feet. Set ground rods not less than 610 mm 2 feet nor more than 3050 mm 10 feet, from the structure. After the completed installation, measure the total resistance to ground using the fall-of-potential method described in IEEE Std 81. Maximum resistance of a driven ground rod shall be 10 ohms, under normally dry conditions [when a ground loop is not used]. Use a ground loop when two of any three ground rods, driven not less than 3050 mm 10 feet into the ground, a minimum of 3050 mm 10 feet apart and equally spaced around the perimeter, give a combined value exceeding 50 ohms immediately after having driven. For ground loop, provide continuous No. 1/0 bare stranded copper cable or equivalent material having suitable resistance to corrosion. Lay ground loop around the perimeter of the structure in a trench not less than 765 mm 30 inches below grade, at a distance not less than 610 mm 2 feet nor more than 3050 mm 10 feet from the nearest point of the structure. Install a ground loop in earth undisturbed by excavation, not earth fill, and do not locate beneath roof overhang or wholly under paved areas or roadways where rainfall cannot penetrate to keep soil moist in the vicinity of the cable. Make connections between ground conductors and grounds or ground loop and between ground loop and grounds electrically continuous. [Where so indicated, provide an alternate method for grounding electrodes in shallow soil by digging trenches radially from the building. Provide 1/0 bare copper cable arranged in a star pattern with the structure at the center for radial systems. Bury the radials at least 765 mm 30 inches below grade external to the structure. Lower ends of down conductors [or their equivalent in the form of metal strips or wires] are buried in trenches].

## **11.6.3.1.7 Grounding Plates**

Provide a grounding plate for down conductor. Set grounding plates not less than 610 mm 2 feet nor more than 3050 mm 10 feet, from the structure. Grounding plate is to be buried as deeply in the existing dirt as local conditions allow, without exceeding 3050 mm 10 feet in depth.

## **11.6.4 APPLICATIONS**

### **11.6.4.1 Nonmetallic Exterior Walls with Metallic Roof**

Bond metal roof sections together which are insulated from each other so that they are electrically continuous. Connect air terminals so that they are electrically continuous with the metal roof as well as the roof conductors and down conductors. Bond ridge cables and roof conductors to the roof at upper and lower edges of roof and at intervals not to exceed 30 m 100 feet. Bond down conductors to roof conductors and to lower edge of metal roof. Where metal of roof is in small sections, make connections between air terminals and down conductors to at least four sections of the metal roof. Make connections electrically continuous and have a surface contact of at least 1935 square mm 3 square inches.

### **11.6.4.2 Metal Roofs with Metal Walls**

Bond metal roof and metal walls so that they are electrically continuous and considered as one unit. Connect air terminals to and make them electrically continuous with the metal roof as well as the roof down conductors. Bond all roof conductors and down conductors to metal roof or metal walls at upper and lower edges at intervals not to exceed 30 m 100 feet. Make all connections electrically continuous and have surface contact of at least 1935 square mm 3 square inches.

### **11.6.4.3 Steel Frame Building**

Make the steel framework of the building electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding unless another specific method is indicated. Connect air terminals to the structural steel framework at the ridge. Provide short runs of conductors to join air terminals to the metal framework so that proper placing of air terminals is maintained.

Separate down conductors from air terminals to ground connections are not required. Where water system enters the building, securely connect structural steel framework and water system at point of entrance by a ground connector. Make connections to pipes by means of ground clamps with lugs. Make connections to structural framework by means of nut and bolt or welding. Make connections between columns and ground connections at bottom of steel columns. Make ground connections to distribute equally around perimeter of structure. When no water system enter the structure, run ground connections from steel columns distributed equally around the perimeter of the structure. Bond metal doors, windows, gutters, and similar metal installation to steel work of the building. Provide a grounding electrode for each ground connection.

### **11.6.4.4 Ramps and Covered Passageways**

Ramps and covered passageways which are in the zone of protection of a lightning protection system, as defined by NFPA 780, need no additional lightning protection. However, ramps and covered passageways which are outside the zone of protection of a lightning protection system shall be provided with a lightning protection conforming to the requirements for lightning protection systems for buildings of similar construction. Place a down conductor and a driven ground at one of the corners where the ramp connects to each building or structure. Connect down conductor and driven ground to the ground loop or nearest ground connection of the building or structure. Where buildings or structures and connecting ramps are clad with metal, connect metal of the buildings or structures and metal of the ramp in a manner to ensure electrical continuity, in order to avoid the possibility of a flash-over or spark due to a difference in potential. Make connections electrically continuous and have a surface contact area of at least 1935 square mm 3 square inches.



## **12. Plumbing**

### **12.1 Pipes**

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturer of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactory at least two years.

Water pipe diameters used in the water distribution network greater than 56mm shall be polyvinyl chloride (PVC) as per ASTM D 1784 and 1785, DIN 8079 PN16 or DIN 8062 PN16, capable of at least 1.03 Mpa (150 PSI) and 1.38 (200psi) hydrostatic test pressure. Water service connections to buildings 75 mm and smaller shall be polyvinyl Chloride (PVC) plastic Schedule 80 ASTM D 1785, or DIN 8079 PN25. Material or equipment containing lead shall not be used in any portable water system. Sewer pipes shall be PVC conforming to ASTM D 3034, Type PSM with a maximum SDR or 35, meeting requirements of ASTM D 1784, cell Class 12454 B, or Din 19531.

### **12.2 Pipe Joints**

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Joints for threaded pipes shall be made with an approved Teflon tape or graphite compound applied to the male threads only. Flanged joints shall be installed for all valve connections. Flanged joints shall be truly parallel to each other so that bolts are used only to tighten joints, rather than to correct alignment. Flanges shall be chosen to suit the maximum working pressure of the pipe system. All PVC pipe joints shall be installed in accordance with the pipe manufacturer's instructions.

### **12.3 Flexible Connection**

Flexible connections at inlets and outlets shall be of neoprene rubber impregnated fabric reinforcement, bellow shape with flanged ends. The flexible connectors shall be designed for excellent vibration and noise protection. Isolated tension members shall be provided to prevent excessive elongation.

Connections of pipes with joints, elbows, or tee shall have thread or pipe solution to prevent water intake.

### **12.4 Air Vents and Drains**

Manually operated air vents shall be furnished as required for purging air or other gases from the water circuits during filling-up. Outlets shall be piped to the nearest drain.

### **12.5 Fixtures**

Fixtures shall be water conservation type. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, and drain fittings.

Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Internal parts of fixtures may contain ABS or other plastic material, if the material has provided satisfactory service for not less than 2 years.

## **12.6 Floor Drains**

Floor drains shall consist of a PVC floor trap, covered with polished stainless steel perforated or slotted grate. A bucket strainer shall be provided in the trench drain in the kitchen for easy cleaning and avoiding the drain from being clogged.

## **12.7 Water Heaters**

Water heater types and capacities shall be as indicated on Drawings. Each water heater shall have replaceable anodes. Water temperature shall be 60 degrees C and 520 kPa working pressure. Water heater shall have vacuum relief valve, pressure/temperature relief valve, and drain valve. Electric type water heaters shall conform to UL 174 or equivalent DIN, I.E.C., BS, or EN standards with dual heating elements. Each element shall be as per design power. The elements shall be wired so that only one element can operate at a time.

## **13 UNITARY HEATING AND COOLING EQUIPMENT**

Use Water Cooler for cooling system and Gas stoves for heating purposes, with the following specification

### **13.1 Material and Equipment**

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products for at least 2 years. Unit shall be factory assembled, weatherproof packaged unit. The ACs must be standard and guaranteed. Contractor must install them correctly according to the client instruction. The units must have approved by the client.

### **13.2 Execution**

Work shall be performed in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

**14. Insulation:** Ceiling and all exposed weather walls will be insulated from inside faces with rigid insulation as indicated in the drawings and details.

The doors and windows are secured, level and plumb, the air gaps between doors or windows and the frame will be filled with expanding foam insulation. Doors will be installed per drawings and Specifications.