Section - 1

EXCAVATION AND EARTHWORK

1. SCOPE

The works covered by this section of the Specifications, consist of furnishing all plant, labor, equipment, appliances and materials, and in performing all operations in connection with earthworks, in accordance with this section of the Specifications and the applicable drawings, subject to the terms and conditions of the Contract.

2. GENERAL

a. The CONTRACTOR shall acquaint himself with the nature of the ground, existing structures, foundations and sub-soil conditions which may be encountered during excavation or other earthworks.

b. The Subsoil Investigation Report is available with the Engineer for reference. However, the Employer does not guarantee or warrant in any way that the material to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Report, Drawings or in any other Contract Documents or to material obtained from boring or trial holes. The contractor shall be deemed to have made local and independent inquiries as to, and shall take the whole risk of the nature of the ground, sub-soil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.

c. All excavation, cutting, embankments and fill shall be constructed to the lines, levels and gradients specified with any necessary allowance for consolidation, settlement and drainage so that at the end of the Period of Maintenance the ground shall be at the required lines, levels and gradients. During the course of the Contract and during the Period of Maintenance, any damage or defects in cutting and embankments, structures and other works, caused by slips, falls or wash-ins or any other ground movement due to the Contractor's negligence shall be made good by the Contractor at his own cost.

3. SITE PREPARATION

a. The CONTRACTOR shall set out the works and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If, at any time, any error in this respect should

appear during the progress of the works, the CONTRACTOR shall at his own expense rectify such an error to the satisfaction of the ENGINEER.

b. The CONTRACTOR shall construct and maintain accurate bench marks, so that, the lines and levels can be easily checked by the ENGINEER.

c. The CONTRACTOR shall construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction.

d. Clearing shall consist of filling and cutting up, or the trimming of trees and the satisfactory disposal of the trees and other vegetation designated for removal, together with downed timber, snags, bushes, and rubbish occurring within the areas to be cleared. Trees, other vegetation, stumps, roots, and bushes in areas to be cleared shall be cut off flush with or below the original ground surface except such individual trees, group of trees, and vegetation as may be indicated on the drawings or designated by the ENGINEER to be left standing. Individual trees, group of trees, and other vegetation, to be left standing shall be thoroughly protected from damage incident to construction operations, by the erection of the barriers or by such other means as the circumstances require, as approved by the ENGINEER. Clearing operations shall be conducted, so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and to provide for the safety of workers. so as to provide for the safety of employees and others.

e. Grubbing shall consist of the removal and disposal of all stumps, roots, larger than 1-1/2" (38 mm) in diameter, matted roots in the designated grubbing areas. Stumps, roots, logs or other timber larger than 1-1/2" (38 mm) in diameter, matted roots & other debris shall be excavated and moved to a depth not less than 18" (450 mm) below any sub-grade, shoulder or slope. In areas, where the cut is over 3 ft (1.0m), grubbing shall not be necessary. In areas to be paved, or in areas indicated on the drawings as future paved areas, where, excess excavation from grading operations is placed, or in areas designated by the ENGINEER as future paved areas, where excess excavation from grading operations is placed, grubbing will be necessary.

f. Timber and other refuse to be disposed off by burning, shall be burned at locations specified by the ENGINEER in a manner that will avoid all hazards such as damage to the existing structures, construction in progress, trees and vegetation. The CONTRACTOR shall be responsible for compliance with all pertinent laws and regulations. Disposal by burning shall be kept under constant attention until the fires have been burned out or have been extinguished. No materials will be permitted to be pushed or placed on adjacent private property without prior written approval of the ENGINEER.

4. EXCAVATION

a. Excavation shall include the removal of all material of every name and nature.

b. The CONTRACTOR shall give reasonable notice that he intends to commence any excavation and he shall submit to the ENGINEER full details of his proposals. The ENGINEER, may require modifications to be made if he considers the CONTRACTOR's proposal to be unsatisfactory and the CONTRACTOR shall effect such modifications but shall not be relieved of any of his responsibilities with respect to such work.

c. For major excavations, the CONTRACTOR shall submit for prior approval of the ENGINEER, full details and drawings showing the proposed method or procedure of supporting and strutting, de-watering and maintenance of adjacent structures. The design, provision, construction, maintenance and removal of such temporary works shall be the responsibility of the CONTRACTOR, and all costs in this respect shall be included in the billed rates for the permanent works.

e. The CONTRACTOR shall preserve the completed excavation from damage resulting from slips and earth movements, ingress of water from any source whatsoever and deterioration by exposure to the sun and the effect of the weather.

f. All excavation of every description in whatever material encountered shall be performed to the elevations and dimensions shown on the drawings in such a manner as to avoid interruption to work in other parts of the site. The contractor shall be responsible for damage to the permanent works caused by excavation in other parts of the work.

g. Excavation shall extend to sufficient distance from walls and footing to allow for placing and removal of forms, installations of services, and for inspection, except where it is required to deposit concrete for walls and footings directly against excavated surface.

h. All excavations in foundations shall be taken to 6" (150 mm) above the final excavation elevations shown on the drawings and the last 6" (150 mm) shall be trimmed carefully to a smooth and level surface. Immediately after trimming to the final elevation a layer of blinding concrete shall be placed to the thickness shown on drawings. All excavations for foundations which have been trimmed shall be covered by lean concrete by the end of the day. It is specifically brought to the notice of the contractor, that, any excavation taken down to the trimmed elevation which is left overnight or for any length of time thereafter, uncovered by the blinding concrete, shall be required to be trimmed to such lower elevation as directed by the Engineer and any extra work or any consequent increase in the quantities caused thereby shall not be paid to the contractor.

i. No excavation shall be refilled nor any permanent work commenced until the foundation has been inspected by the Engineer and his permission to proceed given.

j. If excavation for footings are carried below the required level, as shown in the Drawings or as directed by the Engineer, the surplus depth shall be filled with concrete having f'c = 1.5 ksi at the sole cost of the Contractor.

k. All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry and the Contractor shall have sufficient equipment for this purpose. Adequate precautions shall be taken to prevent any erosion due to undercutting from underneath the previously constructed adjoining foundations. Any de-watering required for this purpose shall be deemed to be included in Contractor's rates for this excavation.

l. Shoring, including sheet piling, where required during excavation, shall be installed to protect workmen and the banks, adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor elects to adopt, with prior approval of Engineer, for upholding the sides of excavation and also for planking and strutting the excavation against the side of public roadways and adjoining properties in existing hard-core of any other material. The Contractor will be held responsible for upholding the sides of all excavations and no claim for additional excavation, concrete or other material will be considered in this respect.

m. Excavations, for deep retaining walls, shall be protected from drying out by covering with tarpaulins or other means, if excavation is to stand open more than 24 hours. This is a precaution to prevent excessive surcharge loads acting on the wall, from the drying out and subsequent swelling of the clay soils when saturated either by rain or capillary action of ground water.

n. If rock is encountered, it shall be removed carefully and without excessive noise and vibration. Blasting, if required shall be done by persons skilled in such work and as directed by the Engineer. Necessary permission for blasting should be obtained from respective Government Authorities by the Contractor. All necessary precautions shall be taken to see that the general public and the properties in the vicinity shall not receive any damage by such blasting. Rock, to receive footings shall be stepped and leveled.

o. Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, which are to be retained, as well as those utility lines constructed during excavation operations, shall be protected from damage during excavation and back-filling, and if damaged, shall be repaired by the Contractor at his own expense. Any existing utility lines, which are not known to the Contractor in

sufficient time to avoid damage, if inadvertently damaged during excavation, shall be repaired by the Contractor and adjustment in payment will be made as approved by the Engineer. When, utility lines which are to be removed, are encountered within the area of operations, the Contractor shall notify the ENGINEER in ample time for the necessary measures to be taken to prevent interruption of the service.

p. Excavated material suitable for use as filling material shall be deposited as directed by the Engineer. Surplus or material unsuitable for use as filling shall be disposed off by the Contractor to areas approved by relevant authorities for this purpose.

5. FILLING

a. After completion of foundation work, walls, and other construction below the elevation of the final grades, and prior to filling, forms shall be removed and the excavation shall be cleaned of trash and debris.

b. Filling shall be approved selected material from excavation and approved by the Consultants or other predominantly granular material and free from slurry, mud, organic or other unsuitable matter and capable of compaction by ordinary means.

c. Filling in trenches and foundations shall be placed in 6" (150 mm) layers and compacted to optimum moisture content by mechanical means, where possible.

d. Filling around pipes and cables shall be carefully placed fine material to cover the pipe or cable completely before the normal infilling is placed.

e. Material for bulk filling shall be as approved by the Engineer and shall be placed in layers of 6" (150 mm) and saturated with sufficient water or otherwise compacted to produce not less than 95% in-situ density with respect to the maximum density, at optimum moisture content, as per ASTM D- 1557 method C. In place determination of dry density of soil shall be by ASTM D-1556-64.

f. All filled areas shall be left neat, smooth and well compacted, the top surface consisting of the normal SITE surface soil, unless directed otherwise.

g. Filling shall not be placed against foundation walls prior to approval by the Engineer. Filling shall be brought up evenly on each side of the walls as far as practicable. Heavy equipment for spreading and compacting the filling shall not be operated closer to the wall than a distance equal to the height of the filling above the top of footing.

h. All structures retaining the earth shall have a fill of granular material for drainage through the weep holes or rubble drain as shown on the drawings or as additionally

directed by the Engineer. This granular material shall consist of following gradation requirements.

SIEVE	% PASSING BY WEIGHT
1-1/2"	100
3/4"	80 - 90
# 4	60 - 70
# 10	45 - 55
# 40	15 - 25
# 100	5 - 15
# 200	less than 5

Drainage mediums shall be free of dirt, chemically inert and well graded so that when placed and compacted this filling shall be stable.

e. Fill material to bring sub-grade for slab on grade, exterior pavements, steps etc. To underside of slab shall be free draining granular material such as concrete sand or approved fill material with fineness modulus between 2.7 & 3.0.

6. EMBANKMENT

a. No embankment shall be commenced until the foundations have been approved by the ENGINEER. When approved as suitable by the ENGINEER, material arising from the excavations may be used for filling as required. Mud, slurry, organic matter, peat and any other unsuitable material shall not be used for filling for any purpose on the SITE. Where suitable materials from the excavations are insufficient for filling, the requirements shall be made up of other granular material which the CONTRACTOR shall obtain from sources approved by the ENGINEER.

b. The location of sources of supply of this filling material will be left to the CONTRACTOR, but the quality of the filling material brought from outside will be subject to the approval of the ENGINEER. The ENGINEER shall require the CONTRACTOR to carry out various tests of the filling material. All such tests, shall be made at an approved laboratory at the cost of the CONTRACTOR.

Once, a material from a specific source has been approved, the material of the same quality and from the same source shall be used. Any filling material from borrow pits, which has not been approved or the quality of which differs from the approved material shall be rejected outright without recourse. The ENGINEER reserves the right to order the removal of any such materials brought to the SITE of the works, at CONTRACTOR's expense.
In order to ensure satisfactory compaction, it will be necessary to carry out, depending upon the type of material, particle size distribution tests, determination of organic

content tests, maximum and minimum density tests and determination of optimum moisture content for the filling material.

c. The method of compaction, namely type of roller, weight of roller and number of passes proposed by the CONTRACTOR for any particular filling material shall be subject to the approval of the ENGINEER, after the completion of satisfactory field tests, subsequent to the laboratory analysis, using the materials and equipment proposed to be used for the earthwork in conditions similar to those likely to be encountered during construction. The final selection of the soil moisture content, the thickness of layers, the type of compaction equipment and the number of passes shall be decided after these tests, which shall be conducted at CONTRACTOR's expense.

d. Having established the method of compaction to be used, no departure from this approved method shall be permitted without the prior approval of the ENGINEER. The adequate control of the filling and compacting operations shall be ensured by in-situ density tests and in order to obtain significant results, not less than two measurements shall be carried out per one thousand square feet (100 square meter) of area compacted. The frequency of tests shall be determined on SITE and may be varied at the discretion of the ENGINEER as the work proceeds. Tests shall be carried out in accordance with ASTM D - 1557 method C or such other standards as approved by the ENGINEER. The standard of acceptance of the compaction be not less than 95% in-situ density with respect to the maximum density, at optimum moisture content, achieved in accordance with ASTM D - 1557 method C.

e. The exact thickness of layers and the method of placing and compacting the filling shall be determined by the field tests, as stated above, but not withstanding the results of these trials, filling shall not be placed in layers exceeding 6" (150 mm) in thickness. The full width of the embankment shall be placed in one operation. In order to maintain control of the thickness of layers, timber profiles shall be used.
The CONTRACTOR shall provide adequate supply of water and sufficient capacity of mechanical water carriers to ensure uniform and uninterrupted operation of compaction. The ENGINEER may forbid the CONTRACTOR to proceed with pacing and/or compaction of filling and/or removal and re-compaction of such filling if he finds that the CONTRACTOR has insufficient or defective equipment or that the work is improper.
If it is found necessary to alter the moisture content of the filling material in any way, then very strict control shall be exercised over the wetting and/or the drying process and frequent moisture content tests shall be made.

f. Where directed, earth slopes shall be protected with hand set stone pitching, either dry or in mortar as specified. Pitching stones shall be approved rock rubble, each stone having a minimum depth of 10" (250 mm) and a minimum volume of 0.5 cubic ft (0.015 C.M).

7. MEASUREMENT AND PAYMENT

a. Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of, but not limited to the following:

i Labor and all cost in connection therewith.

ii Materials, goods and all costs in connection therewith (e.g. conveyance; delivery; unloading; storing; returning, packing; handling; hoisting; lowering).

iii. Setting out of works.

iv. Cost of all laboratory and field tests stipulated in these Specifications.

v. Use of Plant.

vi. Waste of Materials.

vii. Establishment charges, overhead charges & profit.

viii. All other expenses, royalties, charges and taxes specified in Conditions of Contract.

b. Quantities of excavation, filling, embankments, etc. shall be calculated from level taken by the CONTRACTOR and agreed by the ENGINEER before commencement of the work.

c. SITE Preparation
The cost of SITE preparation shall be deemed to be included in cost of excavation.

d. Excavation

i. The quantities given for excavating and subsequent disposal, shall be deemed to be the bulk before excavating and no allowance shall be made for any subsequent variation in bulk or for any extra space required to accommodate planking and strutting.

ii. The unit price for excavation shall be deemed to include the following also:

- Excavating below water-level and excavating in rock.

- Getting out excavated materials by any means necessary and subsequent disposal of excavated material to any lift and lead.

- Keeping excavations free from water, from any source whatsoever, and providing pumps and other equipment, power attendance for pumping and standing time.

- Shoring, which shall mean providing everything requisite to uphold the sides of excavation by whatever means are necessary.

- Placing and compacting of back-filling in the excavations to the required degree and elevations as stipulated in the Drawings and as directed by the ENGINEER.

iii. Excavation and its measurements for foundation/ trenches shall be to the exact dimensions shown on the drawings multiplied by vertical depth of excavation.

iv. The area, shall be that of the lean concrete layer under all footings and shall not include any extra excavation required for shoring, form-work etc. No payment shall be made for any excavation beyond that defined above, or for any unauthorized width and depth.

e. Embankment

i. Quantities for embankment shall be deemed to be the net volume of the embankment after being placed and compacted to the required degree and elevation as stipulated in the Drawings and as additionally directed by the ENGINEER.

ii Treating the surface of the embankment, filling (e.g. leveling, grading to falls, grading to cambers) shall be deemed to be included in the unit price of embankment.

iii. Trimming the sides of embankment to slope shall be deemed to be included in the unit price of embankment.

Section - 2

CEMENT CONCRETE BLOCK MASONRY

1 SCOPE

The work covered by this section of the Specifications consists of furnishing all labour, tools scaffolding, hoisting equipment and masonry materials of every kind; and in performing all operations in connection with procurement, transportation and delivery, erection and building in of all work classified as masonry work and/or included as such herein, i.e., concrete masonry units; masonry mortars; and all related items and appurtenances, including all items supplied by other trades and customarily built-in and/or installed under mason work or required to complete mason work, in strict accordance with the requirements of the Drawings and Schedules, as specified herein, and subject to the Terms and Conditions of the CONTRACT Documents.

2 CODES AND STANDARDS

Unless otherwise specified or shown, the following codes and standards shall apply:

ASTM C31	Making and curing concrete test specimen in the field.
ASTM C39	Compressive Strength of cylinderical concrete specimen.
ASTM C90	Hollow load bearing concrete manonry units.
ASTM C144	Aggregate for manonry mortar
ASTM C270	Mortar for unit manonry
ASTM C404	Aggregate for masonry grout
ASTM E119	Fire tests of building construction and materials
UBC UL-618	Concrete manonry units, fire resistance index
ACI 531	Building code requirements for concrete masonry structure

3 SUBMITTALS

a. Samples:
Submit three samples of each type of block required, and the full range of exposed texture to be used in the completed works. The review will be for texture only

b. Test Reports:
Reports for compressive strengths of masonry units, grout and mortar.

4 SUCTION RATE

The CONTRACTOR shall, at his own cost, satisfy the ENGINEER that the suction rate of the block when determined in accordance with Appendix ‘A’ of BS 3921 does not exceed 20g/cm.sq/min., or that the CONTRACTOR is able to adjust it so that it does not exceed this value on SITE.

5 SOLUBLE SALT CONTENT

For exposed block work, the contents by weight percent of soluble sulfate, calcium, magnesium, potassium and sodium radicals, shall not exceed 0.30, 0.10, 0.03 and 0.03 percent respectively, when ascertained in accordance with BS 3921 at the cost of the CONTRACTOR.

6 PRODUCTS

6.1 Concrete Blocks

6.1.1 Materials for Blocks

Cement, aggregate and water for concrete blocks shall conform to the requirements as specified in the section for Plain and Reinforced Concrete.

6.1.2 Concrete Block Making

a. The blocks shall be machine moulded. The block making machines shall be of the standard approved by the ENGINEER. They shall be operated according to the instructions laid down by the manufacturers.

b. The blocks shall be continuously water cured by sprinkling for a minimum of 10 days and covered between sprinkling operations with 4 mils thick polyethylene sheeting. After 10 days water-curing period the blocks shall be air dried. Under no circumstances will blocks be used in the work until they are completely dry. During curing period no surface of the block will be allowed to dry.

c. Cured concrete blocks shall be stored off the ground, stacked on level platforms, which allow air circulation under stacked units. Units shall be covered and protected against wetting.

d. Care shall be exercised in the handling of all concrete blocks. No damaged blocks shall be used in the work.

e. The blocks cast on different dates shall be stacked separately and must be labeled showing the date on which they are cast.

6.1.3 Properties of Blocks

a. Block sizes, unless otherwise indicated on drawings, shall be 16" by 8" by 4", 6", & 8" thickness (Approximately 400 by 200 by 100, 150 & 200 mm). Physical requirements shall comply with relevant ASTM or equivalent approved standards.

b. For non-load bearing wall the cement, sand and coarse aggregate shall be volume batched in the minimum ratio of one part cement, three parts sand and six parts coarse aggregate and shall be mixed in a concrete mixer.

c. For load bearing Hollow/Solid block wall the mix unless otherwise stated shall be proportioned to meet the following strength requirements:

i) Solid Load Bearing Concrete Masonry Units shall have a 28 day compressive strength of not less than 1500 psi (106 kg/cm. sq.) average of 3 units tested or 1200 psi (85 kg/cm. sq.) per individual unit tested.

ii) Hollow Load Bearing Concrete Masonry Units shall comply with ASTM C90, grade N-1 (moisture controlled), and shall have a 28 day compressive strength of 1350 psi (96 kg/cm. sq.) average of 3 units tested and 800 psi (57 kg/cm. sq.) on individual unit tested. The compressive strengths shall be verified by tests in accordance with UBC section 2404, para 2

d. The CONTRACTOR shall provide test results proving the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test results shall be provided as required by the ENGINEER, to ensure that all batches of blocks have the minimum specified crushing strength.

e. The test shall be carried out by an authority approved by the ENGINEER. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The ENGINEER will require to periodically test samples of blocks, and the CONTRACTOR shall make any necessary arrangements.

f. Hollow concrete block units wherever specified shall have cores with cross sectional area at least equal to the percent of gross area of block given below:

8 in. (200 mm)	38 percent
6 in. (150 mm.)	30 percent
4 in. (100 mm)	No requirement

g. Minimum shell wall thickness be 1-1/4 in. (32 mm).

h. Permissible tolerance in size of block shall be 1/8 in (3 mm) each way.

i Special shapes for lintels, corners, jambs, sash, cleanouts, control joints and headers, bonding and other particular needs shall be provided where required.

B Mortar Constituents

a. Cement:
Cement shall conform to ASTM C-150, type II low alkali non-staining without air entrainment

b. Sand (Aggregate):
Sand and its grading shall comply with the requirements of ASTM C-144, 100% passing the U.S. equivalent No. 16 sieve. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the ENGINEER.

c. Water:
Water shall conform to the specifications set forth in Section of Plain and Reinforced Concrete.

d. Lime:
Hydrate lime shall conform to ASTM C-207 type S. If it is not available use quick lime according to ASTM C-5.

7 MORTAR PROPORTIONS AND MIXING

a. Cement, Lime and Sand shall be mixed in proportion, by volume, as follows: -

Type (1) 1:1:6 (Cement: Lime: Sand)
Type (2) alternatively use 1:4 (Cement: sand) mix subject to the prior approval of the ENGINEER.

b. Mix only as much mortar in a mortar mixer as can be used in one hour for Type-1 and 30 minutes for Type-II after water has been first mixed into the batch.

c. Do not re-temper the mortar.

d. Where cement lime mortar is used, sand and lime shall be mixed first and cement to be added later on.

e. Compressive strength of mortar specimen tested in accordance with ASTM C39 shall not be less than 2500 psi (210 Kg/cm sq.)

8 REINFORCING AND ANCHORS

All masonry walls shall be reinforced. At least one vertical and one horizontal reinforcing member shall be provided for every 16 sq.ft of wall elevation or as per structural drawings.

b. Block masonry anchors and ties required to connect masonry with structural member unless shown otherwise on drawings, shall be 3/8” dia. (10-mm dia) bars every 4-5th course, anchored 6" in each jointing element.

c. Additional details of anchors, if any, are shown on drawings.

d. Alternate compatible anchoring system may be used subject to the approval of the ENGINEER.

e. All reinforcing steel shall conform to ASTM A 615 grade 40 deformed bars as specified in section 3310 plain and reinforced concrete.

9 ERECTION / WORKMANSHIP

a. Blocks shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at center of units in alternate courses below. Each course shall be properly bonded at corners and intersections of walls. Courses of block shall be kept plumb throughout, and corners reveals shall be true and in plumb.

Standard width of mortar joints for both horizontal and vertical joints shall be 1/2" (12.5 mm) maximum. Mortar joints in walls shall have full mortar coverage on vertical and horizontal faces between the blocks. Mortar joints on wall including struck joints, shall be thoroughly compacted and pressed tight against the edges of the blocks with proper tools. Block terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joint shall be packed solidly with mortar between the top of the block and the bottom of slab or beam. Expansion joints shall be kept free from mortar or other debris.

Unless otherwise shown on the drawings or specified by the ENGINEER, the spaces around door frames and other material or built in items shall be solidly filled with mortar. Spaces around the door and window holdfasts shall be filled in with 3 ksi concrete. Work required to be built in with masonry including door frame anchors, wall plugs, dovetail anchors and accessories shall be built in as the erection progresses.

b. The block work shall be carried up in uniform manner and no portion shall be carried more than 3. ft (1 meter) above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and leveled round each floor.

c. Sleeves, chases and holes etc. shall be built in as construction proceeds. Chasing of completed walls or the formation of holes shall only be carried out with the approval of the ENGINEER.

d. Walls of blocks indicated as being non-load bearing shall not be constructed on the in-situ concrete floor slab unit until the floor shuttering is struck and the concrete has obtained sufficient strength to support their weight. Toothing into load bearing walls shall not be permitted.

10 CURING

Masonry wall shall be cured by keeping it moist with water for at least 10 days after its construction. ENGINEER may direct additional curing if required.

11 SCAFFOLDING

CONTRACTOR shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the ENGINEER shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the CONTRACTOR in the unit rate for masonry items.

Damage to masonry from scaffolding or from any other object shall be repaired by the CONTRACTOR at his own cost.

12. TOLERANCES

All block work shall be erected plumb and true to line and level with the maximum variation in any story height or any length of wall being 1/8" (3 mm) in 10 feet (3 meter). The maximum tolerance in the length, height or width of any single masonry unit shall be +/- 1/8" (3 mm).

13. MEASUREMENT & PAYMENT

A Unless otherwise specifically stated in the Bill of Quantities or herein, all items shall be deemed to be inclusive of, but not limited to the following:

i. Labour and all costs in connection therewith.

ii. Materials, goods and all costs in connection therewith e.g. conveyance; delivery; unloading; storing; returning packing; handling; hoisting; lowering; making curing etc.

iii. All fixtures and all costs in connection therewith for precast works.

iv. Fitting and fixing materials and goods in position.

v. Use of plant and scaffolding.

vi. Cutting and patching work required for installation of built-in-work.

vii. Waste of materials.

viii. Square cutting.

ix. Establishment charges, overhead charges and profit.

x. All other expenses, charges and taxes specified in Conditions of Contract.

b. Works shall be measured net as fixed in position as per Drawings and instructions of the ENGINEER. Each measurement shall be taken to the nearest 1/2" (12.5 mm). This rule shall not apply to any dimensions stated in descriptions.

c. Masonry work will be paid for according to the actual net area of masonry work in square feet (Sq. m.) for the
required thickness or the actual net volume of masonry work in cubic feet (C.M.) as described in the Bill of Quantities. All the openings left in the masonry walls will be deducted.

d. Providing and fixing all joint reinforcing bars, reinforcing bar anchors and dovetail anchors shall be deemed to be included in the unit rate for masonry work.

e. Due to different thickness of the slab in different areas or rooms or for any other reason whatsoever, if the chiseling of the masonry is required the CONTRACTOR shall do so at his own cost. Where for any reason whatsoever, the height of the wall is short of ceiling height, the remaining height shall be made good with (f'c = 3000 psi) concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under the item of masonry of the walls. In case where lintel heights are such that the CONTRACTOR has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiseling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate for masonry.

SECTION 3

GENERAL WATERPROOFING

SCOPE

The work covered by this section of the Specifications consists of furnishing all labor, tools scaffolding, equipment and water proofing/ materials of the required kind; and in performing all operations in connection with procurement, transportation and delivery and application/installation etc. of all work classified as water proofing work or included herein, , including all items supplied by other trades and customarily built-in and/or installed under water proofing work or required to complete this work, in strict accordance with the requirements of the Drawings and as specified herein, and subject to the Terms and Conditions of the CONTRACT Documents

PART - A, BITUMINOUS MATERIALS

A.1 CODES AND STANDARDS

The Standards and codes applicable to only a portion of the work specified in this section are referenced in the relevant parts or clauses. Standards and codes which are generally applicable to the work of this section are listed hereinafter :

American Society for Testing and Materials. (ASTM) Standards

D 41 Primer for Use with Asphalt in Damp proofing and Waterproofing.

D 173 Woven Cotton Fabrics Saturated with Bituminous Substances for Use in Waterproofing.

D 226 Asphalt-Saturated Roofing Felt for Use in Waterproofing and in Constructing built-up Roofs.

D 227 Coal-Tar Saturated Roofing Felt for Use in Waterproofing and in Constructing Built-up Roofs.

D 449 Asphalt for Damp proofing and Waterproofing.

D 450 Coal-Tar Pitch for Roofing, Damp proofing and Waterproofing.

D 1665 Woven Glass Fabrics Treated with Bituminous Substances for Use in Waterproofing.

A.2 SUBMITTALS

The following submittals are required:

-Samples
-Certificates of Compliance

A.3 TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

i) Storage

All materials shall be stored in an approved manner and shall be protected from contact with soil and exposure elements.

ii) Roll Materials

All materials delivered in roll type packaging shall be stacked on end at all times.

iii) Temperature control

Bituminous saturated felts or fabrics shall be protected from freezing temperature or ambient temperatures above 38° C (100° F).

A.4 PRODUCTS

a- Asphalt Primer conforming to ASTM D 41.

b- Coal Tar Saturated Felt conforming to ASTM D 227.

c-. Asphalt Saturated 15-pound type Felt conforming to ASTM D 226.

d-. Asphalt Saturated Fabric compatible with membrane system. conforming to ASTM D 173,

e- Glass Fabric, Coal tar or asphalt saturated, compatible with membrane conforming to ASTM D 1668

f- Bitumen

i) Coal Tar Pitch: ASTM D 450, Type B.

ii) Asphalt: ASTM D 449, type best suited to condition of use or as specified.

g-. Protection Board

Seal tight Protection Course (W. R. Meadows, Inc.), Elastiboard (The Celotex Corp.), or approved equal, 3 mm. (1/8 in.) thick.

A.5 EXECUTION

A 5.1 VERIFICATION IN FIELD

Examine the substrates, adjoining construction and the conditions under which the work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

A 5.2. PREPARATION

a. Cleaning and Patching

Cleaning substrate of debris and deleterious material which would impair the work. Patch cracks, voids, and honeycombs to provide a smooth, structurally sound surface. Out off high spots and grind smooth.

b. Prerequisite Work

Do not proceed with membrane waterproofing until all drains, piping, conduit, vents, ducts, and other projections through the substrate have been installed.

A 5.3. INSTALLATION

a- Prime Coat

Prime surfaces in accordance with manufacturer's instructions, except as hereinafter specified. Use either coal-tar or asphalt systems, but only one type shall be used throughout except for first ply which shall be asphalt-saturated felt set in a full mopping of asphalt bitumen.

b- Bitumen Application

Apply not less than the following amount of bitumen per ply to complete waterproofing;

	ASPHALT	**COAL TAR**
Each ply	1.5 kg/m² (0.3 LB/ft²)	1.2 kg/m² (0.25 LB/ft²)
Final Coating	3.0/m² (0.6 LB/ft²)	3.4 kg/m² (0.7 LB/ft²)

c- Laying Membrane

Install each ply as a separate course over the entire surface to be waterproofed, except that on vertical surfaces when 5-ply membrane is shown, install in accordance with manufacturer's instructions. Lay the second and succeeding piles so that each course breaks joints with the underlying courses. Mop the surface of each underlying ply with hot bitumen so that the surface is completely covered and immediately bed the next ply into the hot bitumen. Bond each ply smoothly

and firmly to the preceding ply. Correct any wrinkles or buckles as required to provide a smooth, tight surface without pockets of air.

d-. Penetrations

Flash piping, conduit, and other projections through the membrane with an additional 2 piles of saturated fabric. Embed each ply in bitumen. Extend the first ply not less than 100 mm (4 in.) onto each surface and feather the second ply out 25 mm (1 in.) beyond the first ply. Apply a final coat of bitumen over the top.

e- Membrane Reinforcement

Reinforced membrane waterproofing at internal and external corners and at other points where the membrane may be subjected to unusual strain. Reinforced with 2 piles of saturated fabric as specified for flashing. Unless otherwise shown, extend waterproofing 200 mm (8 in.) on vertical surfaces where membrane is turned up or down.

f- Protection Board

Embed protection board in the final mopping of bitumen while it is still hot. Form a continuous overall protective layer for the membrane waterproofing. Butt edges tightly, stagger end joints and cut to fit at all intersecting surfaces.

A 6. PERFORMANCE REQUIREMENTS

Before completed membranes on horizontal surfaces are covered, test for leaks with a 50 mm (2 in.) depth of water maintained for 24 hours. Examine sub-structure for leaks. Repair leaks, if any, and repeat test until no leakage is observed.

PART - B, ELASTOMERIC MEMBRANE

B 1. GENERAL

This section covers elastomeric membrane where indicated in the Drawings and specified here.

B 2. CODES AND STANDARDS

The standards and codes applicable to only a portion of the work specified in this section are referenced in the relevant parts or clauses. Standards and codes which are generally applicable to the work of this section are listed hereinafter:

ASTM Standards.

D 75 Sampling Aggregates

D 395 Compression Set of Vulcanized Rubber

D 412 Tension Testing of Vulcanized Rubber

D 471 Change in Properties of Elastomeric to Vulcanizes Resulting from Immersion in Liquids

D 573 Accelerated Aging of Vulcanized Rubber by the Oven Method

D 624 Tear Resistance of Vulcanized Rubber

D 746 Brittleness Temperatures of Plastics and Elastomers by Impact

D 1148 Discoloration of Vulcanized Rubber: Organic Finish coated or Light Colored.

D 1149 Accelerated Ozone Cracking of Vulcanized Rubber

D 2240 Indentation Hardness of Rubber and Plastics by Means of a Durometer

B 3. SUBMITTALS

The following submittals are required:

-Details Drawings and / or Shop Drawings

-Assembly, Erection and Installation Drawings and Manuals

-Material, Equipment and Fixture Lists

-Manufacturer's Data

-Certificates of compliance

-Test Reports

B 4. TRANSPORTATION, HANDLING, STORAGE AND PROTECTION

a- Fire Protection

Take all necessary precautions against fire and other hazards during delivery, storage and installation of flammable adhesives, solvents, and other materials specified herein.

B 5. PRODUCTS

B 5.1. MATERIALS

a- Elastomeric Membrane (Sheet)

Fabricated from a vulcanized elastomeric compound containing neoprene as the sole elastomer or approved equal, minimum thickness 2 mm (1/16 in.) unless otherwise indicated; smooth, free of

pinholes and surfaces blemishes, with no evidence of ply delamination, and meeting the following requirements when tested by the referenced ASTM Standards.

Physical Property	Performance Requirements	Test Methods
Hardness, Durometer A	60 + 10	ASTM D 2240
Tensile strength	10.3 MPa (1500 psi) minimum	ASTM D 75
Elongation at break	230 percent minimum	ASTM D 412
Brittleness temperature	-34° C (-30° F)	ASTM D 746
Tear resistance	2100 kg/m (120 lb./in.) minimum	ASTM D 624 (Die C)
Flame resistance	Must not propagate flame	
Resistance to heat aging: Change in original properties after 70 hr. at 100° C (212° F) Hardness Elongation Tensile Strength	 + 10 points maximum - 40 percent maximum - 15 percent maximum	ASTM D 573
Resistance to oil aging. Change in volume after 70 hr. Immersion in ASTM Oil No. 3 at 100° C (212° F)	+ 80 percent maximum	ASTM D 471
Resistance to ozone : Condition after exposure to 100 ppm ozone in air for 500 hr. at 38° C (100° F). Sample under 20% elongation.	No cracks	ASTM D 1149
Resistance to permanent set : Compression set after 22 hr. at 70°C (158° F)	40 percent maximum	ASTM D 395 (Method B)
Resistance to water : Change in weight after 7 days immersion at 70° C (158° F)	+ 10 percent maximum	ASTM D 471
Resistance to discoloration of applied organic coatings	no discoloration	ASTM D 1148

b- Primer, Adhesive, Cleaners and Reinforcing

As recommended by the elastomeric sheet manufacturer and compatible with the neoprene sheet and with the materials to which it is bonded.

c-. Protection Board

Sealtight Protection Course (W.R. Meadow, Inc.), Elastiboard (The Celotex Corp.), or approved equal ; 3 mm (1/8 in.) thick.

d-. Parging

One part Portland cement to three parts sand by volume.

B.6 EXECUTION

B. 6.1 VERIFICATION IN FIELD

Examine the substrates, adjoining construction and the conditions under which the work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

B.6.2 SURFACE PREPARATION

Substrates shall be firm, fully cured, clean and dry, smooth, and free from dust and foreign matter, deleterious and excess materials and projections. Joints shall be neatly struck. Holes, joints, honeycomb, cracks, or cavities shall be pointed or filled and finished flush with Portland cement mortar. Cut of high spots, or grind smooth.

B 6.3. INSTALLATION

a- Laying Membrane
Apply in accordance with the approved manufacturer's recommendations using continuous sheets as large as practicable. Avoid wrinkles and buckles. Complete the work to assure that no water leakage into the system occurs.

b- Joints and Splices
Follow the recommended technique of the membrane manufacturer for cleaning seam, lap and splice areas, and for the method and sequence of forming field joints and splices in the membrane, where such joints are required.

c- Flashing
Flash all pipes, conduits, sleeves, and other projections passing through elastomeric membrane waterproofing and provide tight construction throughout. Use prefabricated boots or field-fabricated boots of uncured neoprene sheet, fitted coverings, and other accessories as required. Where pipes or conduits pass through floor areas to be waterproofed or where floor drains occur in such areas, apply membrane waterproofing only after flashings around pipes, conduits, and drains are in place.

Lap such flashings into the membrane and reinforcing stripes provided as required. Where pipes or conduits which are not flashed pass through floor areas to be waterproofed, clamp the membrane waterproofing to the pipe sleeves with iron clamps and bolts, and solidly caulk with an approved cold-setting fibrated asphalt mastic. Install flashing as shown or required, properly lapped and adhered in place.

d-. Water Cut-off

Provide water cut-off in accordance with the approved membrane manufacturer's recommendations.

e- Membrane Coverage

Elastomeric membrane waterproofing shall cover the entire area of each space designated to be waterproofed, with the waterproofing extending not less than 200 m (8 in.) up or down on vertical surfaces, unless otherwise indicated.

f- Joint Sealing

As soon as the adhesive is fully set and dry, re-check all joints. Where any openings or fish-mouths appear, reseal and re-roll joints.

g-. Membrane Protection

Protect membrane over horizontal surfaces from traffic during and after install at on. Only use rubber-tired vehicles. Provide walkway protection where heavy traffic from other trades is expected. Do not store material on the membrane.

B.7 FLASHING AND REGLETS

a-. Elastomeric Flashings

Provide elastomeric flashings where shown; applied in accordance with the approved manufacturer's recommendations and, generally, as herein specified for installation of elastomeric waterproofing.

b-. Metal Reglets

Continuous metal Reglets, installed as specified in other sections of the specifications, shall receive the exposed edges of membrane waterproofing and elastomeric flashing. Secure membrane into reglet by lead wedges and fill with material as recommenced by manufacturer of waterproofing materials.

c-. Counter-flashing

Reglets and metal counter-flashings are specified in section 4540 "Roof Flashing".

B.8. PERFORMANCE REQUIREMENTS - IN-PLACE TESTING'

Before completed membranes on horizontal surfaces are covered, test for leaks with a 50 mm (2 in.) depth of water maintained for 24 hours. Examine sub-structure for leaks. Repair leaks, if any, and repeat test until no leakage is observed.

B.9. PROTECTION

a-. Vertical Membrane Protection

Protect vertical membrane waterproofing with protection board with all edges butting against adjacent edges.

b-. Horizontal Membrane Protection

Protect horizontal membrane waterproofing with protection board unless parging is shown. Parge not less than 19 mm (3/4 in.) thick, uniformly placed and allowed to set before subsequent construction is installed.

PART - C, LIQUID WATER PROOFING

C.1 GENERAL

This section covers furnishing and installing liquid waterproofing where shown in the Drawings and specified hereinafter.

C.2. APPLICABLE CODES AND STANDARDS

The codes and standards applicable to only a portion of the work specified in this section are referenced in the relevant paragraphs. Codes and standards which generally applicable to the work of this section are listed hereinafter:

ASTM Standards

C 836 High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.

C.3. SUBMITTALS

The following submittals are required:

a-. Details Drawings and/or Shop Drawings (Show edge treatment and changes in plane.)

b-. Manufacturer's Data

c- Installation Manuals

C.4. QUALITY ASSURANCE

The manufacturer shall be a firm with not less than five years of successful experience in supplying the principal materials for the required work.

a-. Compatibility

Where waterproofing is to be installed beneath epoxy mortar, if waterproofing has not previously been successfully applied beneath epoxy mortar, run tests necessary to ensure compatibility and to ensure that waterproofing and tile work will not be detrimentally affected.

C.5 PRODUCTS

C.5.1. MATERIALS

A. Urethane Based Waterproofing, One-Component (for roof access walkway Type UB 1)

Cold applied, monolithic, elastomeric liquid material, self-bonding to all normal substrates, white in color unless otherwise shown, compounded specifically for the application method to be used (by hand or spray) for the slope of substrate, not less than 90 percent solids by weight in the uncured blend, recommended by the manufacturer to comply with the following requirements for the cured membrane.

PHYSICAL PROPRTTIES	PERFORMANCE REQUIREMENTS	TEST STANDARDS/ METHOD
Tensile strength (minimum)	750 psi (5.17 Mpa)	ASTM D 412
Elongation (Min. ultimate)	300%	ASTM D 412
Hardness (Shore 00)	50 Min.	ASTM D 2240
Water Absorption	2%	ASTM D 471
Tear Resistance (Min)	180 psi (1.24 Mpa)	ASTM D 412
Service Temp	-46 C to + 82 C (-50 F to + 180 F)	-----
Fire rating	Suitable for Class a Bldg	----
Adhesion (Min.)	15 psi (103.4 kPa)	FS TT - S- 00227

C.5.2. Urethane Based Waterproofing, Two - Part (beneath ceramic tile/terrazzo/granite except as otherwise indicated) Type UB 2

Polyurethane rubber based liquid materials, self-bonding to all normal substrates, compounded to be compatible with bituminous products, packaged in two components to be mixed at the time of use, compounded specifically for the application method to be used (by hand or spray) and for the

slope of substrate, not less than 97 percent solids in the uncured blend, tested by manufacturer to comply with the following requirements for the cured membrane:

Physical Properties	Performance Requirements	Test Standards/ Methods
Tensile Strength (Min)	40 psi 276 k Pa	ASTM D 412
Elongation (Min ultimate)	400%	ASTM D 412
Hardness (Shore 00)	3 to 5	ASTM D 2240
Water Absorption (Max.)	0.5 % for 21 days at 24 C (75 F)	ASTM D 471
Low Temp Brittleness	-51 C (- 60 F)	ASTM D 746
Heat Aging	No measureable effect from 168 Hours at 70 C (158 F)	ASTM D 573

C.6 MISCELLANEOUS MATERIALS

a) Primer/Filler/Sealer: As recommended by the waterproofing manufacturer and as shown.

b) Flashing, Cant Strips, and Accessories: As recommended by the waterproofing manufacturer as shown.

c) Aggregate: Aggregate shall have a minimum hardness of 6.5 on the Mohs scale. Aggregate shall be sized as recommended by the waterproofing manufacturer so that 75 percent of each granule becomes embedded in the topcoat.

C.7 EXECUTION

C.7.1. JOB CONDITIONS

a-. General

Proceed with the installation of waterproofing only after the substrate construction has been completed, concrete has cured for 28 days minimum and penetrating components have been installed, so that the membrane will not be etched or damaged by subsequent work.

b-. Inspection
Examine the substrates, adjoining construction, and the conditions under which the work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

C.7.2. PREPARATION OF SUBSTRATE

a-. Cleaning

Clean the substrate of dust, debris, oily materials, and other substances detrimental to the work and as recommended by the waterproofing manufacturer.

b-. Accessories

Install cant stripe and accessories as shown and as recommended by the waterproofing manufacturer (even though not shown) in the manner recommended by the manufacturer.

c-. Flashing

Install sheet-type flashing and joint covers where shown and as recommended by the waterproofing manufacturer (even though not shown) in the manner recommended by the manufacturer. If fabric reinforcement is used, embed it in the waterproofing except as otherwise shown, extend flashing onto perpendicular surfaces and other work penetrating the substrate to a point 100 mm (4 in.) from (above) the finished surface to be applied over the membrane. At door openings, extend membrane to top of concrete recess for ceramic tile. At stud partitions, extend sheet flashing up 100 mm (4 in.) behind lathing.

d- Expansion

At locations of possible movement in the substrate construction (including cracks which have developed, width with either a bond-breaker elastic tape (sealed at only the edges) or a heavy coating of inert construction joints, and expansion joints) prepare the substrate to increase the waterproofing capability for bridging the movement without failure. Cover the joint to a 50 mm (2 in.) minimum was-type compound. Use only products which have been determined to the compatible with the waterproofing membrane.

e-.. Sealing

Fill voids and nonmoving cracks and joints in the substrate with sealant or other compound as recommended by the waterproofing manufacturer for compatibility. Fill rough areas of substrate (rough within limitations specified by manufacturer) with a feathered-out coating of waterproofing, squeegee-applied to form a smooth top surface.

f-. Priming

Prime substrate as recommended, and only if recommended, by the waterproofing manufacturer.

g-. Masking

Mask off adjoining surfaces not to receive waterproofing to effectively prevent the spillage or migration of liquid materials outside the membrane area.

C.7.2. INSTALLATION

a-. General

Comply with manufacturer's instructions except where more stringent requirements are shown or specified and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

b-. Mixing

Mix separately packaged components in accordance with manufacturer's instructions.

c-. Application

Apply a uniform coating of waterproofing to the substrate and adjoining surfaces indicated.

a) Apply coating either by hand or by machine spray. Comply with manufacturer's recommendations regarding indicated surfaces.

b) Provide a 1.5 mm (60 mil) average thickness, consisting of base and topcoats where manufacturer recommends, with no variations below a 1.27 mm (50 mil) thickness.

c) At roof access walkway, uniformly apply an excess amount of aggregate into the topcoat. When the topcoat attains a tack-free condition, remove excess aggregate. Apply a compatible glaze coat of 0.25 mm (10 mil) average thickness.

D. Curing

Permit waterproofing to cure without delay and under conditions which will not contaminate or deteriorate the waterproofing material.

C.8 TESTING

Immediately following membrane installation and nominal cure, test horizontal surfaces for leaks in the presence of the Construction Manager by flooding the membrane to a depth of 50 mm (2 in.) for a period of 24 hours. Examine structure for evidence of leakage. Repair leaks, if any, and repeat test until no leakage is observed.

Protection the work. Repair or replace damaged work as required by the Engineer

PART - D, CONCRETE WATER PROOFING

D-1, Through Surface Coating

This section covers furnishing and installing concrete waterproofing through surface coating at all inside cast-in- place concrete surfaces of water reservoirs, basement slab, raft foundations and retaining walls and as specified on the Drawings. In principle, the coating should have the capability to form insoluble crystals into water bearing capillaries and interstices to effectively block passage of water and to ensure permanent water tightness for the life of the structure.

D-1.1 SUBMITTALS

The following submittals are required:

a- Detail Drawings and/or Shop Drawings (For the proposed system to be used and details of construction joint, expansion joint and edge treatment.)

b- Installation Manuals (Include application procedure, storage procedure and curing time.)

c- Samples (Concrete water proofing material, in sealed containers/ bags.)
d- Manufacturer's recommendations for applications.

f- Test Reports (Include certified test report on material properties and field test reports.)

D-1.2 PRODUCT HANDLING

a-. Delivery

Deliver manufactured materials to the site in original, unopened containers clearly indicating manufacturer's name, brand name, and other identifying information.

b-. Storage

Store material in a dry location, off the ground and in such manner as to prevent damage or intrusion of foreign matter. Replace materials which have become damaged or otherwise unfit for use during delivery or storage.

D-1.3 PRODUCT

D-1.3.1 MATERIALS

a-. Concrete Waterproofing Material

Material shall be composed of a compound of chemicals, quartz sand and cement. It shall be supplied in powder form ready to be mixed with water and shall be applied as a slurry coat that waterproofs by crystalline growth through the capillary voids in the concrete substrate. Acceptable products shall be one of the following or approved equivalent:

"Masterseal" by FEB of UK

"Xypex" of Canada,

Equivalent product of Vandex of USA, Fosroc of UK, Grace of Hong Kong and Prokrete of USA or approved equal.

b-. Water

Treated (utility water quality), clean and free of deleterious materials which are determined to impair the strength or bond of the waterproofing materials.

D-1.4 EXECUTION

D-1.4.1 CONDITION OF SURFACES

Examine all concrete surfaces to which the waterproofing material will be applied. Waterproofing material shall be applied only to sound concrete. Concrete surfaces shall be clean and free from all form scale, laitance, formwork oil, curing agents and other foreign materials as per the recommendations of the approved manufacturer.

D-1-4.2 PREPARATION

Prepare the concrete surface for waterproofing treatment in accordance with manufacturer's instructions. Prior to the specified final application of waterproofing material, initial applications to construction joints and repairs to form-tie holes, honeycombed pockets, faulty construction joints, and cracks shall be completed in accordance with manufacturer's instructions.

D-1.4.3. MIXING, APPLICATION AND CURING

a-. Slurry Coat

Apply first slurry coat of the product as per manufacturer's recommendations over any primer if required. Apply second coat if recommended by the manufacturer after a specified time.

b-. Mixing, Application and Curing

Mixing, application and curing of waterproofing material shall be completed by a qualified applicator in accordance with manufacturer's instructions.

D-1.5. CLEANING

Upon completion of work, remove unused materials, containers and equipment from the site. Clean and repair surfaces that are stained, marred, or otherwise damaged by work under this section.

D-1.5.1. CERTIFICATION

Certification of the material and its performance in accordance with the literature submitted earlier for approval, shall be furnished by the supplier from the manufacturer to the satisfaction of the Engineer.

Part - D 2 Waterproofing of Concrete Through Admixture

This section covers furnishing and adding chloride free inorganic copolymer liquid waterproofing admixture that chemically reacts with portland cement to improve the physical and chemical

properties of concrete in all stages of development and also protects reinforcing steel from corroding. This admixture shall be added in all reinforced cast-in- place concrete for water reservoirs, basement slab, raft foundations and retaining walls and all under ground works where subsoil water is in contact with the structure and as specified on the Drawings.

D 2.1 APPLICABLE STANDARDS

ASTM - C 494, Chemical Admixtures for Concrete, Type A

Other internationally recognized standards are also acceptable.

D 2.2 PRODUCTS

Product shall be chloride free inorgaic copolymer liquid water proofing admixture ready to be mixed with other ingrdients of concrete during batching and or mixing. Acceptable products shall be “Ipanex” manufactured by M/s IPA Systems Incorporated, 2745 North Amber St., Philadelphia, PA 19134, USA and “Rheomac 707” manufactured by m/s FEB represented in Pakistan or any other equivalent product of M/s Fosroc, Grace, Vandex and Prokrete etc approved by the Engineer.

D 2.3 SUBMITTALS

The Contractor shall submit all the technical literature and job site dispensing procedure to the Engineer for approval prior to commencement of work.

D 2.4 STORAGE

The product shall be stored at site as per the manufacturer’s recommendations.

D 2.5 MIXING

The admixture shall be added at the rate of 16 Oz/112 Lb (50 Kg) bag of cement or as recommended by the manufacturer. After adding the admixture the, the drum shall be rotated at a maximum speed for five minutes or as recommended by the manufacturer.

D 2.6 CURING

Standard procedure for the curing as specified in the “Plain and Reinforced Concrete” shall be adopted.

PLAIN AND REINFORCED CONCRETE

1. SCOPE

The work covered by this section of Specifications consists of furnishing all plant, labor, equipment, appliances and materials, and in performing all operation in connection with the supply and installation of plain and reinforced concrete work, complete in strict accordance with this section of the Specifications and the applicable drawings, subject to the conditions of the CONTRACT.

2. GENERAL

a. Full co-operation shall be given to other trades to install embedded items.

b. Suitable templates or instructions, or both will be provided for setting items not placed in the forms. Embedded items shall have been inspected, and tests for concrete and other material or for mechanical operations shall have been completed and approved, before concrete is placed.

c. For special concrete finishes and for special methods of construction (e.g. slip forms), formwork shop drawings shall be designed and prepared by the CONTRACTOR at his own cost. Approval of shop drawings as well as that of actual samples of finished concrete shall be obtained before WORK is commenced.

d. CONTRACTOR shall also prepare BAR BENDING SCHEDULE, and get the same approved by the ENGINEER, prior to commencement of work.

e Approximate equivalent conversion of F.P.S. and S.I. units are indicated in the text. Engineer's decision on any specific conversion shall be final and binding on all parties.

3. RELATED SPECIFICATIONS

Latest editions of the following British, ASTM and ACI Standards are relevant to these Specifications where indicated:- (Equivalent Pakistan Standards are also applicable.)

A British Standards

B.S. 12-78	Portland Cement, Ordinary and Rapid Hardening (in lieu of C-150).
B.S. 410	Test Sieves.
B.S. 693	General Requirements for Oxyacetylene Welding of Mild Steel
B.S. 882-1201	Concrete aggregates from Natural Sources.

B.S. 1141	Cold Worked Steel Bars for the reinforcement of Concert. General Requirements for the Metal-Arc Welding of Mild Steel.
B.S. 1881	Methods of Testing Concrete.
B.S. 3148	Tests for Water for Making Concrete.
B.S. 4027	Sulfate-Resisting Portland Cement.
B.S. 4449	Carbon Steel Bars for the Reinforcement of Concrete.
B.S. 4461	Cold Worked Steel Bars for the Reinforcement of Concrete.

b. Latest ASTM Standards:

c.

A 615-94	Deformed Billet-Steel Bars for Concrete Reinforcement.
C 33-93	Standard Specification for Concrete Aggregates.
C 39-93a	Compressive Strength of Cylindrical concrete Specimens.
C 42-90	Standard Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
C 94-94	Standard Specification for Ready Mixed Concrete.
C 138-92	Standard test method for unit weight, Yield, and Air Content (Gravimetric) of Concrete.
C143-90a	Standard Method of Test for Slump of Hydraulic Cement.
C 150-94	Standard Specification for Portland Cement.
C 171-92	Standard Specification for Sheet Materials for Curing Concrete.
C 172-90	Standard Method of Sampling fresh Concrete.
C 173-94	Standard Method of Test for Air Content of freshly Mixed Concrete by the Volumetric Method.
C 208	Standard Specification for Insulating Board (Cellulosic Fiber) Structural and Decorative.
C 231-91b	Standard Method Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
C 260-94	Standard Specifications for Air Entraining Admixtures for Concrete
C309-93	Standard Specification for Liquid Membrane-Forming Compounds for curing Concrete.
C 494-92	Standard Specification for Chemical Admixtures for Concrete.
E 329-90	Specification for minimum requirements for agencies engaged in the testing and or inspection of materials used in construction

c ACI Standards:

ACI 318	Building Code Requirements for Reinforced Concrete

d. In addition, the latest editions of other Pakistan and British Standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other Standards as may be specified by the ENGINEER for special Materials and Construction are also relevant.

4.0 Materials

4.1 Aggregates (Except for light-weight concrete):

a. The sources of supply of all fine and coarse aggregates shall be subject to the approval of ENGINEER.

b. All fine and coarse aggregates shall be clean and free from clay, loam, silt, and other deleterious matter. If required, ENGINEER reserves the right to have them washed by the CONTRACTOR at no additional expenses. Coarse and fine aggregates shall be delivered and stored separately at SITE. Aggregates shall not be stored on muddy ground or where they are likely to become dirty or contaminated.

c. Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings and shall conform to requirements of ASTM C-33.

d. Coarse aggregate shall be gravel or broken stone or hard, durable material free from laminated structure and conforming to ASTM C-33 graded as follows for use in mass concrete such as in foundations:

TOTAL PASSING		PERCENT BY WEIGHT
2" B.S	Sieve (50.00 mm)	100
1-1/2"	Sieve (38.10 mm)	95 - 100
3/4"	Sieve (19.00 mm)	35 - 70
3/8"	Sieve (9.50 mm)	10 - 30
No. 4	Sieve (4.75 mm)	0 - 5

Coarse aggregate for all cast-in-place concrete other than mass concrete and thick fair faced cast-in-place concrete shall be graded with the following limits:-

TOTAL PASSING		PERCENT BY WEIGHT
1"	Sieve (25.00 mm)	100
3/4"	Sieve (19.00 mm)	90-100
3/8"	Sieve (9.50 mm)	20- 55
No. 4	Sieve (4.75 mm)	0- 10

Coarse aggregate for thin fair faced cast-in-place concrete shall be graded as follows:-

TOTAL PASSING		PERCENT BY WEIGHT
1/2"	Sieve (12.50 mm)	100
3/8"	Sieve (9.50 mm)	85-100
No. 4	Sieve (4.75 mm)	10- 30

e. The nominal maximum size of aggregate for precast fair faced concrete shall be smallest of the following:

i One-fifth of the narrowest dimensions between sides of forms.

ii One-third of the depth of slabs.

iii. Three-fourth of the minimum clear distance between reinforcing bars or between bars and form.

iv. 1/2" (12.0 mm).

f. The nominal maximum size of the aggregate for normal weight precast concrete shall be smallest of the following:-

i. One-fifth of narrowest dimension between forms.
ii One-third of depth of slab.
iii Three-fourth of clear distance between bars.
iv. 1"

g. The aggregate shall be stockpiled for a period before use so as to drain nearly to constant moisture content (as long as SITE and other conditions permit, preferably for at least a day). The grading of the coarse and fine aggregate shall be tested at least once for every 50 tons (or 750 C. ft) supplied to ensure that the grading is uniform and the same as that of the samples used in the preliminary tests.

4.2 Cement:

a. Cement shall conform to ASTM C - 150.

b. Only one brand of each type of cement shall be used for concrete in any individual member of the structure.

c. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed. There shall be sufficient cement at SITE to ensure that each section of WORK is completed without interruption. If the cement is

supplied by THE OWNER, the CONTRACTOR shall inform ENGINEER of his requirement much before its use in construction.

d. Cement reclaimed from cleaning of bags or from leaky containers shall not be used.

e. CONTRACTOR shall provide and erect, at his own cost, in a suitable place, dry, well ventilated, and water proof shed of sufficient capacity to store the cement.

f. The cement shall be used as soon as possible after delivery, and cement which ENGINEER considers has become stale or unsuitable through absorption of moisture from the atmosphere or otherwise shall be rejected and removed immediately from the SITE at CONTRACTOR's expense. Any cement in containers, damaged so as to allow the contents to spill or access of the atmosphere to the cement prior to opening at the time of concrete mixing shall be rejected and removed immediately from the SITE at CONTRACTOR's expense.

g. The mixing together of different types of cement shall not be permitted.

4.3 Water:

Clean and clear water which does not have sweet, saline or brackish taste to be used for mixing and curing of concrete. Where doubt exists, the strength of mortar sample made with questionable water is compared with mortar sample produced with acceptable water (like distilled water). The questionable water may be accepted if the sample yield concrete strength of at least 90% of the other sample made with acceptable water.

Water contaminants under no circumstance shall be greater than following limits:-

Oil	--------	0.00 ppm.
Chlorides	--------	1000 ppm.
Sulfates	--------	1000 ppm.
Turbidity	--------	2000 ppm.
Acids	--------	10,000 ppm.

Potassium and NaOH 0.5 to 1.0% by weight of cement.

Sea water shall not be used for any reinforced concrete works or where concrete is later required to be plastered, painted or otherwise decorated.

4.4 Reinforcement:

a. Reinforcement for concrete shall conform to the respective British, ASTM or other standards as specified in the Drawings and CONTRACT Documents or as may be specified by ENGINEER.

b. Unless otherwise specified, all plain reinforcing bars shall comply with the requirements of B.S. 4449 for plain mild steel bars and shall have a minimum yield stress of 36 ksi, (248 N/mm sq).

c. Unless otherwise specified, all deformed reinforcing bars shall comply with the requirements of B.S. 4461 for deformed cold worked steel bars and shall have minimum yield strength of 60ksi, (460 N/mm sq). with a minimum elongation of 12%.

d. Reinforcement shall be obtained only from the manufacturer approved by the ENGINEER. If and when required CONTRACTOR shall provide all necessary facilities to ENGINEER for the selection of test pieces and shall cause these to be prepared and submitted where directed for tests at CONTRACTOR's cost.

e. If the reinforcement is to be supplied by the OWNER, the CONTRACTOR shall inform ENGINEER of his requirements much before its use in construction.

f. CONTRACTOR shall report immediately on receipt of any consignment, having any deviation in the standard weights of the reinforcing bars beyond those allowed in respective standards mentioned in clause (4.4.b) and (4.4.c) herein before.

5. CONCRETE MIX PROPORTIONS

5.1 General:

a. The proportions of ingredients shall be such as to produce a mixture which will work readily into the corners and angles of the forms and around reinforcement by the methods of placing and consolidation employed on the WORK, but without permitting the materials to segregate or excessive free water to collect on the surface. Specific approval of the ENGINEER is required to waive limitations on mixture proportions.

b. The proportions of ingredients shall be selected in accordance with Section 5.6 to produce the proper placeability, durability, strength and other required properties.

5.2 Strength:

The Specified compressive strength of the concrete cylinder, shall be 3000 psi, (21 N/mm sq) except where otherwise noted on Drawings. The equivalent cube strength shall be at least 25% higher than the specified cylinder strength. Strength requirements shall be based on the sampling and testing methods of ASTM C 39-72 (and BS 1881 for cube).

5.3 Durability:

Maximum permissible water-cement ratios for concrete in severe exposures to be as follows, unless lower water-cement ratio is required to meet specified strength limits:

Type of Structure	**Structure** continuously wet or frequently freezing and thawing[1]	**Structure** exposed to sea or sulfates
i. Thin sections & sections with less than 1" cover over steel	0.45	0.40[2]
ii. All other Structures	0.50	0.45[2]

[1] Concrete should also be air-entrained.
[2] If S. R. Cement is used, permissible water-cement ratio may be increased by 0.05.

5.4 Slump:

Unless otherwise permitted or specified, the concrete shall be proportioned and produced to have a slump of 4" (100 mm) or less. A tolerance of upto 1" (25 mm) above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated. The slump shall be determined by the "Test for Slump for Portland Cement Concrete" (ASTM C-143).

5.5 Admixtures:

If required or permitted, admixtures used shall be in accordance with the manufacturer's instructions except as otherwise specified herein.

5.6 Methods of Obtaining Mix Design:

For concrete of normal weight, mix proportions to provide the desired characteristics shall be developed using the methods/procedure covered by the latest edition of

Recommended Practice for Selecting Proportions for Normal Weight Concrete ACI 211.1.

Trial mixtures having proportions and consistencies suitable for the WORK shall be made based on ACI 211.1, using at least three different water-cement ratios which will produce a range of strengths encompassing those required for the WORK. Trial mixes shall be designed to produce the specified slump. The temperature of concrete used in trial batches shall be reported.

For each water-cement ratio, compression test of cylinder/cube shall be made, cured, and tested in accordance with "ASTM C - 39 or BS 1881". From the results of these tests a curve shall be plotted showing the relationship between the water-cement ratio and compressive strength. From this curve, the water-cement ratio to be used in the concrete shall be selected to produce the required/specified design strength. The cement content and mix proportions to be used shall be such that this water-cement ratio is not exceeded when slump is the maximum permitted. Control in the field shall be based upon maintenance of proper cement content and slump.

6. PLANT AND WORKMANSHIP

6.1 Formwork:

a. Forms shall be used, wherever necessary, to confine the concrete and shape it to the required dimensions. Forms shall have sufficient strength to with-stand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.
Structurally adequate, form work shall also conform to the requirements of the special architectural finishes of the in-situ Plain and Reinforced Concrete specified/or shown on the Drawings. Shop drawings of such form shall be subject to the approval of the ENGINEER prior to its use. ENGINEER shall refuse concreting of any part which in his opinion may not yield specified finishes.

b. Earth cuts shall not be used as forms for vertical surface or reinforced concrete work unless required or permitted.

c. Mud centering shall not be permitted without the prior approval of the ENGINEER.

d. Formwork shall be made of either timber, steel, plywood, proprietary building boards and such special material, as may be shown on the drawings or approved by the ENGINEER which gives the required finish to the surface of concrete. Wooden frame work shall be free from loose knots and shall be well seasoned. For the external concrete finishes 1/16" (1.5 mm) thick mild steel

sheet forms shall be used. CONTRACTOR shall furnish shop drawings of such formwork prepared on the basis of architectural concept for the approval of the ENGINEER.

e. Formwork shall conform to the shape, lines and dimensions as shown on the plans, and be so constructed as to remain sufficiently rigid during the placing and compacting of concrete, and shall be sufficiently tight to prevent loss of cement slurry. The design and Engineering of the formwork, as well as its construction, shall be the responsibility of CONTRACTOR. Where necessary to maintain the specified tolerances, the formwork shall be **cambered** to compensate for anticipated deflections in the formwork due to the weight and pressure of the fresh concrete and due to construction loads.

CONTRACTOR shall establish and maintain in an undisturbed conditions, and until final completion and acceptance of the WORK, sufficient control points and bench marks to be used for reference purpose to check tolerances.

f. Requirements for facing materials are given in clause 8 "Finishing of formed Concrete". The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

g. Where natural plywood form finish, grout cleaned finish, smooth rubbed finish, scrubbed finish, or sand floated finish is required, forms shall be smooth (faced with plywood, liner sheets, or prefabricated panels) and true to line, in order that the surfaces produced with required little dressing to arrive at true surfaces. Where any as-cast finish is required, no dressing shall be permitted in the finishing operation.

h. Where as-cast surfaces, including natural plywood form finish, are specified, the panels of materials against which concrete is cast shall be arranged orderly with joints between panels planned in approved relations to opening, building corners, and other architectural features.

i. Where panels for as-cast surfaces are separated by recessed or otherwise emphasized joints, the structural design of the forms shall provide for locating form ties within the, joints so that patches of tie holes will not fall within the panel areas.

j. Forms shall not be re-used if there is any evidence of surface wear and tear or defect which would impair the quality of the surface. Forms shall be thoroughly cleaned and properly coated before re-use.

k. The formwork may be designed so that soffits of slabs and sides of beams, columns, and wall may be removed first leaving the forms to the soffits of beams and their supports in position.

l. Positive means, wedges or jacks of accurate adjustment and proper removal of shores and struts shall be provided and all settlement shall be taken up during placing of concrete. Forms shall also be securely braced against lateral deflections.

m. Where concreting of narrow members is required to be carried out within formwork of considerable depth, temporary openings in the sides of the formwork shall be provided where necessary to facilitate the placing and consolidation of the concrete. Small temporary openings shall be provided at the bottom of the formwork to columns, walls and deep beams to permit the cleaning out of debris and observations immediately before concrete is deposited.

n. Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than twice the diameter or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4" (19 mm) when the formed face of the concrete is not to be permanently exposed to view, form tie may be cut off flush with the formed surfaces. Through bolts shall be permitted provided that they are greased to allow for easy withdrawal and the holes subsequently made good. Through bolts are not to be used on water-retaining structures.

o. At construction joints, contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by not more than 1" (25 mm). The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint and to maintain a true surface.

p. Runways or planks for moving labor and equipment shall be provided with struts or legs and shall be supported directly on the formwork or structural member without resting on the reinforcing steel.

q. All surfaces of the embedded items shall be cleaned and any accumulated mortar or grout from previous concreting and of all other foreign material is removed before concrete is placed in them.

r. Board forms having joints opened by shrinkage of the wood shall be swelled until closed by wetting before concrete is placed. Plywood and other wood surface not subject to shrinkage shall be sealed against absorption of moisture from the concrete either by (1) a field applied, approved form oil or sealer, or (2) a factory applied non- absorptive liner. When forms are coated to prevent bond with concrete, it shall be done prior to placing of the reinforcing steel. Care shall be taken that such approved coating is kept out of contact with the reinforcement. Where "as-cast" finishes are required, materials, which may impart a stain to the concrete shall not be applied to the form surfaces. Where the finished surface is required to be painted, the material applied to form surface shall be compatible with the type of paint to be used.

s. In normal circumstances generally where temperatures are above 68°F (20°C) where ordinary cement is used, forms may be struck after expiry of the following periods.

-	Walls, columns and vertical sides of beams	48 hours or as directed by the ENGINEER.
-	Slabs (Shores or props left under, removal and refixing of props not permitted).	10 days
-	Beams soffits(Shores or props left under, removal and refixing of props not permitted).	14 days
-	Removal of shores or props to slabs:	
	1. Spanning upto 14 ft. (4 meters)	14 days
	2. Spanning over 14 ft. (4 meters)	21 days
-	Removal of shores or props of beams:	
	1. Spanning upto 20 ft. (6 meters)	21 days
	2. Spanning over 20 ft. (6 meters)	28 days

For rapid hardening cement 1/2 of the above period will be sufficient in all cases except vertical sides of slabs, beams and columns which should be retained for a minimum of 24 hours.

t. Proper allowance shall be made for the decrease in rate of hardening of concrete in cold weather and the minimum periods must be increased when the mean daily temperature is below 68°F, (20°C).

u. When repair of surface defects or finishing is required at an early age, forms shall be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

v. Top forms on sloping surfaces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or the treatment required on such sloping surfaces shall be performed at once and followed by the specified curing.

w. All formwork shall be removed without such shock or vibration as would damage the reinforced concrete.

x. When re-shoring or re-propping is permitted or required, the operations shall be planned in advance and shall be subject to approval. While re-shoring is underway no live load shall be permitted on the new construction. In no case during re-shoring shall concrete in beams, slab, columns or any other structural member be subject to combined dead and construction loads in excess of the load permitted by ENGINEER for the developed concrete strength at the time of re-shoring. Re-shores shall be placed simultaneously with stripping operations are but in no case later than the end of working day on which stripping occurs.

Re-shores shall be tightened to carry their required loads without over stressing the concrete. Re-shores shall remain in place at least until representative tests of the concrete being supported have reached the strength/time specified in 6.1.s.

y. Floors supporting props or shores under newly placed concrete shall have their original supporting props or shores left in place or shall be re-shored. The re-shoring system shall have a capacity sufficient to resist the anticipated loads and in all cases have a capacity equal to at least one half of capacity of the shoring system above. The re-shores shall be located directly under a shore position above unless other locations are permitted.

The re-shoring or re-propping shall extend over a sufficient number of stories to distribute the weight of newly placed concrete, forms, and construction live

loads in such a manner that the design superimposed load of the floors supporting shores or props are not exceeded.
No loads, other than those permitted by the ENGINEER in connection with the actual work in hand, shall be allowed on suspended floors until 28 days after concreting where ordinary Portland cement is used and 14 days when rapid hardening Portland cement is used.

z. It is required to give forms for reinforced concrete an upward camber to ensure that the beams or slabs including cantilever slabs do not have a sag when they have taken up their deflection. Camber, unless indicated otherwise on drawings, should be about l/240 for supported beams and slabs and l/180 for cantilevers.

6.2 Reinforcement:

a. All metal for reinforcement shall be free from loose mill scale, loose rust, mud, oil, grease, or other harmful matter immediately before the concrete is placed.

b. Reinforcement is to be accurately placed as shown in the Drawings, and secured against displacement by using 18-20 gauge black annealed wire ties or suitable slips at intersections and supported from the formwork by using concrete, metal or plastic chairs and spacers or hangers of an approved pattern.
Where concrete blocks are used for ensuring the cover they shall be made of mortar not leaner than 1 part of cement to 2 parts of sand. Where the concrete surface will be exposed to the weather in the finished structure the portions of all accessories in contact with the formwork shall be galvanized or shall be made of plastic.

c. Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the Bending Schedule.

d. The cutting tolerance for all bars shall be +/-1" (+/- 25 mm).

e. Where an overall or an internal dimension of a bent bar is specified in the schedule, the bending tolerance, unless otherwise stated, shall be as in Table 1.

TABLE 1--BENDING TOLERANCES

DIMENSIONS OF BENT BARS				TOLERANCE			
Over Upto and Including				Plus/Minus			
Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
--	--	36	900	1/8	3	1/4	6.0

36	900	72	1800	1/4	6.0	½	12.0
72	1800	--	--	1/2	12.0	1	25.0

f. Bars shall be placed to the following tolerances:

i. Concrete cover to formed surface: +/- 1/4" (6.0 mm)

ii. Minimum spacing between bars: +/- 1/4" (6.0 mm)

iii. Top bars in slabs and beams:

* Members 8" (200 mm) deep or less: +/- 1/4" (6.0 mm)

* Members more than 8" (200 mm) but not over 24" (600 mm) deep: +/- 1/2" (12.0 mm)

* Members more than 24" (600 mm) deep: +/- 1" (25 mm)

iv. Crosswise of member: spaced evenly within 1" (25 mm)

v. Lengthwise of members: +/- 2" (50 mm)

g. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, resulting arrangement of bars shall be subject to approval of the ENGINEER.

h. Vertical bars in column shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all columns dowels.

i. Reinforcement shall not be bent or straightened in a manner that will injure the material. No bars shall be bent twice in the same place, nor shall they be straightened after bending.

Unless permitted by the ENGINEER, reinforcement shall not be bent after being partially embedded in hardened concrete. Bars which depend for their strength on cold working shall not be heated for any reason (except for welding) Reinforcement larger than 1-1/2" (38.0 mm) in dia may be bent by

the use of heat at (not exceeding 1550 °F). Bars bent shall not be cooled by quenching.

j. No splice of reinforcement shall be made except as shown on the working Drawings.

k. Welding shall be permitted for bars only under suitable conditions and with suitable safeguards in accordance with B.S 693. 1856, or AWS D 12.1, provided the type of reinforcement bars have the required welding properties. Tack welding may be used to fix in position bars that cross each other, only with prior approval of the ENGINEER.

l. Exposed reinforcement intended for bonding with future extensions is to be effectively protected from corrosion. Protection is also to be provided to reinforcement partly built into concrete exposed part to be built into later concrete.

m. No concreting is to be carried out until the reinforcement has been checked and approved by the ENGINEER.

6.3 Batching:

a. All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement, unless marked otherwise, may be taken as 112 lbs (50 kg) or as directed by the ENGINEER

b. Aggregate shall be batched by weight, due allowance being made for water content. Aggregate may be batched by volume only with the prior permission of ENGINEER. The apparatus for weight batching may be an integral part of the mixer or a separate unit of a type approved by ENGINEER.. It shall be accurate within 2% and shall be checked for accuracy at least once a week.

c. Where the batching plant is of the type in which cement and aggregate are weighed in the same compartment, the cement shall be introduced into the compartment between two sizes of aggregate.

d. Where volumetric batching of aggregate is permitted gauge boxes shall be provided for measuring the coarse and the fine aggregate. These shall be **deep and narrow rather than shallow and wide.** Tests for the bulking of sand shall be made at intervals and the necessary quantity of sand added.

e. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period which may extend to the end of the first 25 percent of the specified mixing time.

6.4 Mixing:

a. The concrete shall be mixed in an approved batch mixer conforming to the requirement of B.S 1305. It shall be fitted with the manufacturer's plate stating the rated capacity and the recommended number of revolutions per minute and shall be operated in accordance therewith. It shall be equipped with a suitable charging mechanism and an accurate water measuring device.

b. Mixing shall continue for the period recommended by the mixer manufacturer or until apparently the mix is uniform in color, whichever period is longer. If it is desired to use a mixing period less than 1-1/2 minute ENGINEER's approval shall be obtained in writing.

c. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three quarters of the required mixing time shall take place after the last of the mixing water has been added.

d. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10% of their original height.

e. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be retempered, but shall be discarded.

6.5 Transport:

a. The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means which will prevent segregation or loss or addition to ingredients. It shall be deposited as nearly as practicable in its final position so as to avoid re-handling or flowing. All skips vehicles, or containers used for transporting the concrete shall be thoroughly cleaned.

b. During hot or cold weather, concrete shall be transported in deep containers to minimize the loss of water/heat.

6.6 Placing:

a. Before placing of concrete, formwork shall have been completed, water shall have been removed, reinforcement shall have been secured in place, expansion joint material, anchors, and other embedded items shall have been kept in position, and the entire preparation shall have been approved.

No concrete is to be placed into the foundation trenches until the ground to receive the same has been examined and approved by ENGINEER for this purpose.

c. The actual sequence of construction proposed by CONTRACTOR shall be subject to ENGINEER's approval before construction starts on any part of the

structure, and this sequence shall not be varied without ENGINEER's prior approval.

d. The concrete shall be placed after it has been mixed as soon as is practicable. Once the concrete has left the mixer no more water shall be added, although the concrete may be mixed or agitated to help maintain workability. The concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means are available.

The time between mixing and placing should be reduced if the mix is richer or the initial workability of the mix is lower than normal, if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere. CONTRACTOR shall ensure that the delay between mixing and placing does not exceed 30 minutes under any circumstances. Any concrete which does not satisfy this requirement shall not be used.

e. The concrete shall be deposited as nearly as possible in its final position to avoid re-handling. In no circumstances may concrete be made to flow along the forms by the use of vibrators. Concreting shall be carried out on as a continuous operation using methods which shall prevent separation or loss of ingredients.

f. The free fall of concrete shall not be allowed to exceed eight feet and where it is necessary for the concrete to be lowered more than this amount, it is not to be dropped into its final position, but it is to be placed through pipe, the lower end of which shall be kept in, or close to the freshly deposited concrete. The dia. of the pipe shall be not less than 4 times the maximum size of aggregate.

g. For mass concrete, concrete shall be placed in layers approximately 18" (450 mm) thick. Vibrator heads shall extend into the previously placed layer.

h. The workmen carrying concrete to the SITE, and all other workmen moving about before the concrete is placed shall move only along runways or planks placed over the forms.

i. Prior to the laying of concrete on load bearing masonry walls, bearing plates and at other points, as may be directed by ENGINEER, the surface will be brought to a true, hard smooth, level using a cement sand mortar in the ratio of 1 volume of cement to 3 volumes of sand. Two layers of building paper weighing 1.3 oz/sq. ft (400 g/m) will then be laid flat to separate the concrete from the surface on which it is to be laid.

6.7 Construction Joints:

a. Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be pre-determined with the approval of the ENGINEER.

b. Joints not shown on the Drawings shall be so made and located as to least impair the strength of the structure and shall need prior approval of ENGINEER. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset to a distance equal to twice the width of the secondary beam. Joints in walls and columns shall be at the underside of floors slab or beams, and at the top of footings. Beams, brackets, columns, capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

c. All reinforcing steel shall be continued across joints. Key and inclined dowels shall be provided as directed by ENGINEER. Longitudinal keys at least 1- 1/2" (40 mm.) deep shall be provided in all joints in walls and between walls and slab or footings.

d. When the work is to be resumed on a surface which has hardened, such surface shall be roughened in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

e. The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in un-exposed walls and all others not mentioned below shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

f. The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete The grout shall be as thick as possible on vertical surface and at least 1/2" (12.0 mm) thick on horizontal surface. The fresh concrete shall be placed before the grout has attained its initial set.

g. Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brush. Care being taken to avoid dislodging of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 6" (150 mm) in thickness, and shall be well rammed against old work, particular attention being paid to corners and close spots.

h. Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in the concrete with prior written approval of ENGINEER. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement. Wood strips inserted for architectural treatment shall be kerfed to permit swelling without pressure on the concrete.

6.8 Embedded Items:

a. The material, design and location of water stops in joints shall be as indicated in the Drawings. Each piece of pre-molded water stop shall be of maximum practicable length in order that the number of end joints will be held to a minimum.

Joints at intersections and at end of pieces shall be made in the manner most appropriates to the material being used. Joints shall develop effective water tightness fully equal to that of the continuous water-stop material, and shall permanently develop not less than 50% of the mechanical strength of the parent section, and shall permanently retain their flexibility.

b. Electric conduits and other pipes which are planned to be embedded shall not, with their fittings, displace more than four percent of the area of the cross section of a column on which stress is calculated or which is required for fire protection. Sleeves, conduits, or other pipes passing through floors, walls, or beams shall be of such size or in such location so as not to impair unduly the strength of the construction. Such sleeves, conduits in compression in the displaced concrete, provided that they are not exposed to rusting or other deterioration, are of uncoated or galvanized iron or steel not thinner than standard steel pipe, have a nominal inside diameter not over 2" (50 mm) and are spaced at centers not less than thrice their diameter. Except when plans of conduits and pipes are approved by ENGINEER embedded pipes or conduits other than those merely passing through, shall not be larger in outside diameter than one-third the thickness of the slab, walls, or beam in which they are embedded nor shall be spaced closer than three diameters on center, nor so located as to impair unduly the strength of the construction. Sleeve pipes, or conduits with-in the limitations of this section may be embedded in concrete with the approval of ENGINEER, provided they are not considered to replace the displaced concrete.

c. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

d. Expansion joint material, waterstops and other embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

6.9 Consolidation:

a. All concrete shall be consolidated by vibration, so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of form, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Internal vibrators shall have a minimum frequency of 800 vibrations per minute and sufficient amplitude to consolidate the concrete effectively.

Vibrators shall be inserted and withdrawn at points approximately 18" apart (450 mm). At each insertions, the duration shall be sufficient to cause consolidation, generally from 5 to 15 sec. A spare vibrator shall be kept on the SITE during all concreting operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

b. If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall be modified to affect an improvement in the quality of the concrete to the satisfaction of ENGINEER and in conformity with the provisions of Clause 5.

c. Vibrators shall not be allowed to contact the formwork for exposed concrete surface.

d. Mechanical vibrators shall be of a type suited in the opinion of ENGINEER to the particular conditions.

e. Over-vibration or vibration of very wet mix is harmful and should be avoided.

6.10 Curing and Protection:

a. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury, and shall be maintained with minimal moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval of ENGINEER.

b. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion and finishing:

- Ponding or continuous sprinkling.
- Application of absorptive mats or fabric kept continuously wet.
- Application of water proof sheet materials approved by ENGINEER.
- Application of other moisture retaining covering as approved.
- Application of curing compound conforming to ASTM C 309. The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any sheen which develops after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other materials to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from area to receive bonded applications.

c. Moisture loss from surface placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the limit prescribed in Clause 6.10.d by one of the methods of Clause 6.10.b.

d. Curing in accordance with clause 6.10.a & 6.10.b shall be continued for at least 14 days in the case of all concrete except concrete with Rapid hardening Portland cement for which the period shall be at least 7 days.

Alternatively if tests are made of cylinders/cubes kept adjacent to the structure and cured by the same methods, moisture retention measures, unless stated otherwise on drawings, may be terminated when the average compressive strength has reached 70 percent of the minimum specified works strength. If one of the first four curing procedures of clause 6.10.b is used initially, it may be replaced by one of the other procedures of that Clause any time provided the concrete is not permitted to become surface dry during the transition.

e. When the mean daily outdoor temperature is less than 41 degree F (5 C) then temperature of the concrete shall be maintained between 50-68°F (10°C-20°C) for the required curing period of Clause 6.10.d. When necessary arrangements for heating, covering, insulation or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless approved

precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.

f. When necessary, provision for windbreak, shading for spraying, sprinkling, ponding or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

g. Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5°F (3°C) in any one hour or 50°F (28°C) in any 24 hour period.

h. During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods by application of curing procedures, and by rain or running water, self-supporting structures shall not be loaded in such a way as to over stress the concrete.

6.11 Works in Extreme Weather:

a. Unless adequate protection is provided and approval is obtained concrete shall not be placed during rain. Rain water shall not be allowed to increase the mixing water nor to damage the surface finish.

b. When the temperature of the surrounding air is expected to be below 40 degrees F (4.4 C) during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed shall be no lower than 55 degrees F (13 - C) for sections less than 12" (300 mm) in any dimension nor 50°F (10°C) for any other sections.

When necessary, concrete materials should be heated before mixing and carefully protected after placing; in general, heating of mixing water alone to about 140°F (60°C) may be sufficient for this purpose. Dependence should not be placed on salt or other chemicals for the prevention of freezing. No frozen material or materials, containing ice shall be used. All concrete damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 5.5 gallons (25 liters) per bag of cement. If water or aggregate is heated above 100°F (38°C) the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 100°F (38°C).

c. During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90°F (32.°C). For massive concrete this temperature should not exceed 70°F (21.°C). When the temperature of the concrete exceeds 90°F (32°C),precautionary measures approved by ENGINEER shall be put into effect. When the temperature of the steel is greater than 122°F (50°C) steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.
Other precautions recommended by ACI standard 305R-91 shall also be adopted.

7. TEST FOR CONCRETE QUALITY

7.1 General:

CONTRACTOR shall provide samples of concrete for testing at ENGINEER's direction. Proper facilities shall be provided for making and curing the test specimens in accordance with the specifications. A competent person shall be employed by CONTRACTOR whose first duty shall be to supervise all stages in the preparation and placing of the concrete. All test specimens shall be made and SITE tests carried out under his direct supervision and at CONTRACTOR's cost.

7.2 Samples:

Conduct strength tests on at least one test sample per 50 cubic yards of concrete (38 cu meters) with a minimum of 3 sample per concrete pour. Each test sample shall consist of no less than 9 concrete test cylinders made from a single sample of concrete from a randomly selected batch of concrete, taken at point of discharge from mixer or truck, cured under standard conditions. 3 cylinders from each sample shall be tested at age 7 days, 3 at age 14 days and 3 at age 28 days unless otherwise directed by the ENGINEER.

7.3 Adequacy of Mix:

In case of Concrete mix, the appropriate strength requirement shall be considered to be satisfied if none of the strengths of the specimen is below the specified strength or if the average strength of the three specimens is not less than the specified strength and the difference between the greatest and least strengths is not more than 20% of that average.
When the results of tests show that the strength of any concrete is below the minimum specified, ENGINEER may give instructions for the whole or part of the work

concerned to be removed and be replaced at the expense of CONTRACTOR. CONTRACTOR shall bear the cost of any other part of his, or any other CONTRACTOR's work, which has to be removed and replaced as a result of the defective concrete. If any concrete is held to have failed, ENGINEER may order the proportions of that class of concrete to be changed in order to provide the specified strength.

8. FINISHING OF FORMED CONCRETE

8.1 General:

a. After removal of forms the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Drawing or as specified in Clause 8.5.

b. When finishing is required to match a small sample furnished to CONTRACTOR, the sample finish shall be reproduced on an area at least 100 square feet in an inconspicuous location designated by ENGINEER before proceeding with the finish in the specified location.

8.2 As-Cast Finishes:

a. Rough Form Finish:

No selected form facing materials shall be specified for rough form finish surfaces. Tie holes and defects shall be patched, Unless if required to be retained if so directed by ENGINEER. Fins exceeding 1/4" (6 mm) in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

b. Smooth Form Finish:

The form facing material shall produce a smooth hard uniform texture on the concrete. It may be plywood, tempered concrete-form grade hardboard, metal, plastic paper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edge, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

8.3 Architectural Finishes:

a. Textured Finishes:

Textured form liners may be of formed plastic sheet, wood, sheet metal, or other material designated in Drawings. Liner panels shall be secured in forms by cementing or stapling, but not by methods which will permit impressions of nail heads, screw heads washers, or the like to be imparted to the surface of the concrete, unless shown otherwise on the Drawings. Edges of textured panels shall be sealed to each other or to dividing strips, if specified or shown, to prevent bleeding of grout. The sealant used shall be non-staining to the surface.

b. Applied Finishes:

When finishes of plaster or similar trowelled materials are to be applied, the surface of the concrete shall be prepared to ensure permanent adhesion of the finish. If the concrete is less than 24 hours old, it can be roughened with a heavy wire brush or scouring tool. If the concrete is older the surface may be roughened mechanically or by etching with dilute hydrochloric acid. After roughening, the surface shall be washed free of all dust, acid, chemical retarder, and other foreign material before the final finish is applied.

8.4 Rubbed Finishes:

The following finishes shall be produced on concrete with a smooth form finish. Where smooth rubbed finish is to be applied, the forms shall have been removed and necessary patching completed as soon after the placement of the concrete as possible without compromising any structural requirements.

a. Smooth Rubbed Finish:

Smooth rubbed finish shall be produced on newly hardened concrete not later than a day following form removal.

Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process.

b. Grout Cleaned Finish:

No cleaning operations shall be undertaken until all contiguous surfaces to be cleaned are completed and accessible. Cleaning as the work progresses shall not be permitted.

Mix 1 part Portland Cement and 1-1/2 part fine sand with sufficient water to produce a grout having the consistency of thick paint. White Portland Cement shall be substituted for a part of the grey Portland Cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with a brush or a spray gun. Immediately after applying the grout, scrub surface vigorously with a cork float or stone and fill all air bubbles and holes. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, sack or other means. After the surface whitens from drying (about thirty minutes at normal temperature) rub vigorously with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.

c. Cork Floated Finish:

1. Remove forms at an early stage, within 2 to 3 days of placement where possible.

2. Remove ties, and all burrs and fins.

3. Mix 1 part Portland cement and 1 part fine sand with sufficient water to produce a stiff mortar.
4. Dampen surface.

5. Apply mortar with firm rubber float or with trowel, filling all surface voids.

6. Apply a small amount of water with a fog spray to prevent too rapid drying of compressed mortar.

7. Apply a small amount of water with a fog sprayer.

8. Produce the final texture with a cork float using a swirling motion.

8.5 Unspecified Finishes:

If the finish is not designated in the Drawings, the following finishes shall be used as applicable:

a. Rough Form Finish:

For all concrete surface not exposed to public view and / or are specified to have subsequent finishing.

b. Smooth Form Finish:

For all concrete surfaces exposed to public view and or are not required to have subsequent finishing.

8.6 Related Unformed Surfaces:

Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the formed surfaces. Final treatment on form surfaces shall continue uniformly across the unformed surfaces.

9. REPAIR OF SURFACE DEFECTS:

9.1 General:

a. Any concrete failing to meet the specified strength or not formed as shown on Drawings, concrete with surface beyond tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of ENGINEER shall be removed and replaced at CONTRACTORS's expenses. ENGINEER may reject any defective concrete and order it to be cut out in part or in whole and replaced at the CONTRACTOR's expense. Only in case of minor surface defects, ENGINEER may approve a surface treatment in accordance with the Clause. 9.2

b. All ties and bolt holes and all repairable defective areas shall be patched immediately after the removal of forms.

9.2 Repair of Defective Areas:

a. All honeycombed and other defective concrete shall be removed down to sound concrete. The area to be patched and area at least 6" (150 mm) wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand or an approved bonding agent shall then be well brushed/ applied into the surface.

b. The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2-1/2 parts sand by damp loose volume. White Portland cement shall be substituted for a part of the grey Portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch.

c. The quantity of mixing water shall be not more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to

stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

d. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to loose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the parch slightly higher than the surrounding surface to permit initial shrinkage; it shall be left undisturbed for at least one hour before being finally finished. The patched area shall be covered by approved curing compound, except as specified in Clause 9.2 g. Metal tools shall not be used in finishing a patch in a formed wall which will be exposed.

e. Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as-cast concrete surfaces shall not exceed 2 square ft. in each 1000 square feet (2 sq. m in each 1000 sq.m) of as-cast surface. This is in addition to form tie patches, if the project design permits to fall within as-cast areas.

f. Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces. The mix formula for patching mortar shall be determined by trial to obtain a good color match with the concrete when both patch and concrete are cured and dry. After initial set, surface of patches shall be dressed manually to obtain the same texture as surrounding surfaces.

g Patches in architectural concrete surfaces shall be cured for 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

9.3 Tie and Bolt Holes:

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar.

9.4 Proprietary Materials:

If permitted or required by ENGINEER proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendation with prior approval of ENGINEER.

10. CONCRETE CONSTRUCTION TOLERANCE

Where tolerances are not stated in the Specifications or Drawing for any individual structure or feature, maximum permissible deviations from established lines, grades and dimensions shall

conform to the following. The CONTRACTOR is expected to set and maintain concrete forms so as to ensure completed work within the tolerance limits. These allowable tolerances shall not relieve CONTRACTOR of his responsibility for correct fitting of indicated materials. These tolerances are not cumulative.

10.1 Variation from the plumb (or as specified for sloped walls).

a. In the lines and surfaces of columns, piers and walls.

*	In any 10 ft (3 m) of length or height:	1/4" (6 mm)
*	In any storey or 20 feet (6 meters) Max:	3/8" (10 mm)
*	Maximum for the entire length or height:	3/4" (20 mm)

b. For exposed corner columns, control joint grooves and other conspicuous lines.

*	In any bay or 20 feet (6 meters) maximum:	1/4" (6 mm)
*	Maximum for the entire length or height:	1/2"(12.0 mm)

10.2 Variation from the levels or the grades indicated on Drawings:

a. In floors, ceilings, beam soffits, and in arrises.

*	In any 10 feet (3 meters) of length:	1/4" (6 mm)
*	In any bay or 20 feet (6 meters) feet maximum:	3/8" (10 mm)
*	Maximum for the entire length:	3/4"(20 mm)

b. For exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:

*	In any bay or 20 feet(6m) maximum:	1/4" (6 mm)
*	Maximum for the entire length:	1/2"(12.0 mm)

10.3 Variation of the entire building lines from established position in plan and related position of columns, walls and partitions.

a.	In any bay or 20 feet (6 m) maximum:	1/2" (12.0 mm)
	* Maximum for the entire length:	1" (25 mm)

10.4 Variation of the size and locations of sleeves, floors openings and wall openings:
1/4" (6 m)

10.5 Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls.

Minus:	1/4" (6 mm)
Plus:	1/2" (12.0 mm)

10.6 Footings:

a. Variations in dimensions in plan.

*	Minus :	1/2"(12.0 mm)
*	Plus (plus variation applied to concrete only, not to bars dowels):	2" (50 mm)

b. Misplacement or eccentricity of concrete.

* 2 percent of the footing width in the direction of misplacement but not more than 2"(50 mm)

c. Reduction in thickness

* Minus 5 percent of specified thickness.

10.7 Variation in Steps

a.	Rise:	1/8" (3 mm)
	Tread:	1/4" (6 mm)
b.	In consecutive steps Rise:	1/16" (1.0 mm)
	Tread:	1/ 8" (3 mm)

10.8 Tolerance for Precast Concrete:

Forms must be true to size and dimensions of concrete members shown on the plans and be so constructed that the dimensions of the finished product will be within the following limits at the time of placement of these units in the structure, unless otherwise noted on ENGINEER's Drawings.

a.	Overall dimensions of members per 10 ft (3 mm)	+/- 1/16" (1.0 mm)
b.	Cross-sectional dimensions Section less than 3"(75 mm)	+/- 1/16" (1.0 mm)
c	Section over 3" (75 mm) less than 18" (450 mm)	+/- 1/ 8" (3 mm)
d	Section over 18" (450 mm)	+/- 1/ 4" (6 mm)
e	Deviations from straight lines in long sections.	Not more than 1/8 inch per10 ft. (3mm / 3 m)
f	Deviation from specified camber	+/- 1/16" (1.5 mm) per 10 ft (3m) of span
g	Maximum differential between adjacent units in erected position	1/4 inch (6 mm)

10.9 Tolerance for Pavements:

a. Ramps

Departure from established alignment	+/- 1/2 inch (12.0 mm).
Departure from established longitudinal	+/- 1/4" (6 mm) grade on any line.
Departure from transverse template contour except at transverse joints	+/- 1/8 inch (+/- 3 mm).
Departure from transverse template control at transverse joints	+/- 1/4"(+/-6 mm) in width of one traffic lane

10.10 Pavements for Parking Areas:

Twice values listed for ramp pavements.

11. ACCEPTANCE OF STRUCTURE

11.1 General:

a. Completed concrete work which meets all applicable requirements will be accepted subject to the other terms of the CONTRACT Documents.

b. Completed concrete work which fails to meet one or more requirements and which has been repaired to bring it into compliance will be accepted subject to the other terms of the CONTRACT Documents.

c. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the CONTRACT Documents. In this event, modifications complies with the requirements.

11.2 Dimensional Tolerances:

a. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of Section 10 considered potentially deficient in strength and subject to the provisions of Section 11.4.

b. Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of Section 10 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance. Permission is required if excess material is to be removed in accordance with this Section.

11.3 Appearance:

a. Architectural concrete with surface defects exceeding the specified limitations shall be removed in accordance with this Section.

b. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected or misplaced items interfere with other construction.

c. Inaccurately formed concrete surfaces exceeding the limits of Section 6 & of Section 10 and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.

d. Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.

e. Concrete not exposed to view, but of defective appearance, may be accepted at the discretion of the ENGINEER.

11.4 Strength of Structure:

a. The strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions:

- Concrete strength requirements not considered to be satisfied in accordance with Section 7.
- Reinforcing steel size, quantity, strength, position or arrangement at variance with the requirements of Section 4.4 & 6.2 of the CONTRACT Documents.
- Concrete which differs from the required dimensions or location in such a manner as to reduce the strength.
- Curing less than that specified.
- Inadequate protection of concrete from extreme temperature during the early stages of hardening and strength development.
- Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
- Poor workmanship likely to result insufficient strength.

b. Structural analysis and/or additional testing may be required when the strength of the structure is considered potentially deficient.

c. Core tests may be required when the strength of the structure is considered potentially deficient.

d. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with ACI Standard 318.

e. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction, if so directed by ENGINEER or shall be replaced, at the CONTRACTOR's expense.

f. The CONTRACTOR shall pay all costs incurred in providing the additional testing and/or analysis required by this Section.

g. THE OWNER will pay all costs of additional testing and/or analysis which is made at his request and which is not required by specifications, or the CONTRACT Documents.

12. METHODS OF MEASUREMENT OF CONCRETE WORKS

12.1 General:

a. Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of, but not limited to, the following:

i. Labor/plant and all costs in connection therewith.

ii. Materials, goods and all costs in connection therewith, e.g. conveyance, delivery, unloading, storing, returning, packing, handling, hoisting, lowering.

iii. All fixtures and all costs in connection therewith for precast works.

iv. Fitting and fixing materials and goods in position.

v. Waste of materials, and Square cutting.

vi. Mixing, transporting, hoisting, placing in from at any level, compacting through vibration & curing etc. complete including the cost of formwork & its removal(but excluding cost of reinforcement).

vii. Establishment charges, overhead charges and profit.

viii. All other expenses, charges and taxes specified in Conditions of CONTRACT.

b. Works shall be measured net as fixed in position as per drawings and instructions of ENGINEER. Each measurement shall be taken to the nearest 1/2" (12.0 mm). This rule shall not apply to any dimensions stated in the descriptions.

12.2 Concrete:

a. Concrete shall be measured as executed but no deduction shall be made for the following:

- Volume of any steel embedded in the concrete.

- Volume occupied by water pipes, conduits etc., not exceeding 4 square inch (2500 sq. mm) each in cross-sectional area.

- Voids not exceeding 1 square foot in work given in square feet and 0.1 sq M in work given in Sq Meters. If any void exceeds above limit total void shall be deducted.

- Voids not exceeding 1 cubic foot in work given in cubic feet, 0.03 cubic meter in work given in cubic meter. If any void exceeds above limits, unit total void shall be deducted.

b. Voids, which are not to be deducted as per Section 12.2.a above, refer only to openings or vents which are wholly within the boundaries of measured areas. Openings or vents which are at the boundaries of measured areas shall always be subject to deduction irrespective of size.

c. Junctions between straight and curved works shall in all cases be deemed to be included with the work in which they occur.

d. Concrete work shall be classified and measured separately as follows unless otherwise described elsewhere:-

- Buildings, foundation beams, foundation slabs, footings, bases of columns, machine foundations, mass concrete etc., in cubic feet (Cu Meter).

- Floor slabs on ground with floor beams in cubic feet (Cubic Meter).

- Walls in foundations, plinth and superstructure in cubic feet (Cubic Meter) stating thickness.

- Columns, piers, pilasters, pillars etc., in cubic feet (Cubic meter).

- Lintels, beams and brackets in cubic feet (Cubic Meter).

- Suspended floors, roofs and stair landings in square feet (sq. Metre) stating thickness.

- Stairs (excluding landing) in cubic feet (Cubic Meter).

- Railings in cubic feet (Cubic Meter), square feet (Sq. Meter), or linear feet (Meter) stating description.

- Parapets, purdees and the like in cubic feet (Cubic Meter) stating thickness.

- Jali, blocks in square feet (Sq. Meter) stating thickness & description.

- Precast concrete items shall each be enumerated except if otherwise shown in the Bill of Quantities, separately stating the description.

e. Measurement of walls shall be taken between attached columns, piers or pilasters. The thickness of attached columns, piers or pilasters shall be taken as the combined thickness of the wall and the columns, piers or pilasters. Attached or isolated columns, piers, pilasters and the like (except where caused by openings) having a length on plan not exceeding four times the thickness shall be classified as columns. Those having a length over four times the thickness and caused by openings in walls shall be classified as walls.

Columns shall be measured from the top of footings/beams or floor surfaces to the under side of beams or slabs as the case may be. Where the width of the beams is less than the width of columns, the extra width at the junction shall be included in the beam.

The depth of the beams shall be measured from bottom of the slab to the bottom of the beams, except in case of inverted beams where it shall be measured from top of slab to the top of beam. The cross section below or above the slab.

12.3 Formwork:

a. Formwork (if separate and extra payment is specifically stated in the Bill of Quantities) shall be measured in square feet (Sq. M) as the actual surface of the finished structure which required to be supported during the deposition of the concrete, including the upper surfaces to the work sloping more than 15 degree from the horizontal. No allowance shall be made for overlaps and passing at angles and no deduction shall be made for the following:-

- Voids not exceeding ten square feet(1 Sq. m).
- Intersections of main beams with walls or columns.
- Intersections of secondary beams with main beams.

b. Formwork shall be deemed to be inclusive of, but not limited to items detailed in section 12.1 and the following:-

- Batten, struts, reversed cut strings, bolting, oiling, wedging, easing, striking, removing and making good exposed faces of concrete after removal of formwork. Also yokes, wales sheathing, jack rods, jacks, working platforms and finishers, scaffolds, etc.

c. Forming chamfers not exceeding 2" (50mm) wide and forming splayed internal angles not exceeding 1/2" (12.0 mm) wide shall not be paid for extra.

d. Temporary stop ends for constructed joints shall not be measured and paid for.

e. Classification of formwork (if separate and extra payment is specifically stated in the Bill of Quantities) shall be as follows:-

- To horizontal or sloping soffits of suspended slabs, floors, roofs, staircases, landings and the like.
- To sloping upper surfaces of suspended slabs, floors, roofs and the like where more than 15 degree from horizontal.
- To vertical or battering sides of foundations, foundation beams and slabs, ground beams, machine foundations and the like.
- To vertical or battering sides of walls, solid balustrades and the like.
- To vertical or battering sides.
- To vertical or battering sides of stanchion casings, columns, piers, plasters and the like.
- To sides and soffits of openings in walls, recesses in walls, projecting panels on walls and the like.
- To sides and soffits of horizontal or sloping beam casings, beams, brackets, lintels, staircase, strings and the like.
- To sloping upper surfaces of beam casings, beams, brackets, lintels, staircase-strings and the like where more than 15 degrees from horizontal.
- To edges of beds, roads, footpaths, paving and the like.
- To edges of suspended slabs, floors, roofs, landing and the like.
- To risers of steps and staircases.
- To sides of kerbs, up stands and the like.

f. Formwork to throats, grooves, chases, rebates, chamfers over 2" wide (50 mm) splayed internal angles over 1/2" wide (12.5 mm) moldings and the like shall each be measured separately in linear feet stating the size.

12.4 Rate for Reinforcement:

a. The rate tendered for any type of reinforcement by the CONTRACTOR shall also be inclusive of the cost of binding wire wastages, and the cost of concrete, metal or plastic chairs and spacers or hangers, etc.

b. All reinforcement shall be provided in length shown in Drawings and as per Specifications.
Should the CONTRACTOR provide lengths of reinforcement which are greater than shown on the Drawings no payment of extra length shall be made. Overlaps, unless clearly shown in working Drawings, shall not be allowed and measured.

c. The CONTRACTOR shall be paid for reinforcement by weight computed from Table-2 and from linear measurements of reinforcements actually used at SITE as per the Drawings, Specifications and instructions of ENGINEER. No payment shall be made for steel chairs or wastage. CONTRACTOR shall not claim for the difference in the actual weights of bars and their standard weights given in Table -2.

TABLE-2:

Nominal Bar Diameter		Weight
(Inches)[1]	**Bar Number**	**lbs/ft**
1/4"	-	0.167
3/8"	# 3	0.376
1/2"	# 4	0.668
5/8"	# 5	1.043
3/4"	# 6	1.502
7/8"	# 7	2.044
1"	# 8	2.670
1-1/8"	# 9	3.400

1-1/4"	#10	4.303
1-3/8"	#11	5.313
1-3/4"	#14	7.650
2-1/4"	#18	13.600

(mm)	(kg/m)
8	0.395
10	0.616
12	0.887
16	1.576
20	2.463
22	2.980
25	3.849
28	4.828
32	6.306
36	7.981

[1]To the nearest 1/8

Section - 5

ROOF TREATMENT
(WATER PROOFING AND HEAT INSULATION)

1. SCOPE

The work covered by this section of the Specifications consists of furnishing all plant, labour, equipment, appliances and materials and in performing all operations in connection with Heat Insulation between walls, and installation of Water Proofing and Heat Insulation over RCC Roof Slab, flat or sloped as indicated on the Drawings, in strict accordance with this section of the Specifications, and subject to the terms and conditions of the Contract.

2. MATERIALS

a. Asphalt priming oil shall be made by the manufacturer of the asphalt.

b. Bitumen shall be Hy-Carb, A-10 or equivalent or as specified in the Drawing with following characteristics of Hy-carb shall apply:

Softening Point: 80^{O}C to 90^{O}C (204^{O}F) min; (224.6^{O}F) max.
Penetration when 100 gms. load is applied at 25^{O}C is 1/10 mm.
Specific gravity at 25 C (770 F):1.02 to 1.06.

c. Thermal insulation shall be expanded polystyrene moulded bead-board type (self extinguishing/fire resistant) of minimum density 2 lbs per cu.ft (32 kg/m). Thickness as shown on Drawings. For exterior wall application, use "Styroking" sheets as manufactured by Household products (Pakistan) Ltd, Pakistan or equal.

d. Brick Tiles shall be Burnt Clay Tile of sound quality 12" x 12" 1-1/4" thick (300 x 300 x 30mm thick).

e. Cement, aggregate and water shall be in accordance with Specifications for, "Plain and Reinforced Concrete".

f. Materials and methods not specifically described but required for proper installation, shall be provided by the Contractor subject to prior approval of Engineer, at no additional cost to Owner.

g. Samples of all materials proposed for used under this Section shall be submitted to the Engineer for his approval.

3. PRODUCT HANDLING AND DELIVERY

a. Deliver materials to the job Site and store in a safe dry place with all labels intact and legible at time of installation.

b. Protect materials before, during, and after installation and protect the installed work and materials of other trades.

c. Do not leave insulation exposed to sunlight. Keep it covered with clean or light coloured material. Apply finish material soon after installation of the insulation. Brush off any sunlight degraded surface material prior to adhering insulation.

d. Boards/sheets chipped, cracked or squashed shall be rejected in the event of damage, immediately make repairs and replacements to the entire satisfaction of Engineer, at no additional cost to Owner.

4. PREPARATORY WORK

a. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

b. Verify that building insulation may be installed in acordance with the original design and the manufacturer's recommendations.

c. In the event of discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until they have been fully resolved.

d. All surfaces to receive water proofing and insulation should be sound, clean, smooth, dry and free of debris, loose material or defects which would otherwise have an adverse effect on the application, bonding, and performance.

5. APPLICATION OF ROOFING

5.1 Base Layer (Screed):

a. Apply cement sand base layer to an average thickness of approximately 40mm, over concrete slab. Mix to consist of one part cement to six (6) parts sand aggregate to Engineer's approval.

b. Wet concrete base slab before screeding.

c. Spread and place screed to conform with slopes indicated on Drawings. Apply in alternate bays not exceeding 250 sq. ft (25 Sq.M. Approx). Form canted fillets at up-stands.

d. Screeding and tamping shall be done immediately after spreading to achieve prescribed slopes.

e. The screed shall then be smoothened and consolidated to a uniform close textured surface with a wood float, to remove high and low spots exceeding 1/4 in (6mm) in 10 ft (3 M. Approx). Avoid excessive floating.

f. Areas showing signs of laitence will be subject to rejection by the Engineer. These faulty areas shall be replaced at no additional cost to the Owner.

g. Screed layer shall be cured for a minimum of 7 days after finishing.

h. Allow sufficient time for screedto thoroughly harden and dry before allowing other work to be carried out.

5.2 Water Proofing:

a. Prime sloping screed surface with a uniform coating of asphalt primer at the rate of 5 liters (1.1 gals) per 10 sq.m. (12 Sq.yds).

b. Apply uniform coating of Bitumen Hi-Carb, A-10 to a minimum thickness of 1/8" (3 mm approximately) or 30 kg (60 lb.) per 10 sq.m. (100 sq.ft.).

c. Asphalt shall not be applied when its temperature is above 205 C (401 F) nor shall it be heated above 245 C (473 F), or as recommended by the manufacturer.

d. Heating of asphalt shall be strictly regulated by means of an accurate thermometer of approved type, kept constantly suspended in the heating kettle while the work is in progress.

e. Water proofing shall not be laid when the temperature at the location of the work is below 5° C.

f. Water proofing shall not be applied during rain or while surfaces are damp; it shall be applied only to surfaces that are clean and dry.

g. Method of laying water proofing shall be strictly in accordance with the instructions of the Engineer.

5.3 Heat Insulation:

a. Install roof insulation un-bonded over water proofing membrane with boards butted tightly together and end joints staggered.

5.4 Roof Finish:

a. Lay burnt clay tiles immediately over insulation. The tiles shall be soaked two hours before installation.

b. Set tiles in patterns with 1/2" (12.5mm) mortar joints. Joints shall be grouted and tooled with cement sand mortar, tinted to match colour of tiles.

c. Area to receive tiles shall be set out to correct alignment, gradients etc.

d. Lay tiles with joints butted and aligned in both directions but not coincidental with insulation joints. Set out tiles to roof areas so that distance remaining at perimeter walls, to receive in situ concrete edge, are equal but are not less than 12 in (300mm) and not greater than 18 in (450mm).

e. Cut tiles square to face to a tolerance of 1/8 in (3mm). Cutting shall be kept to a minimum.

f. Ensure alignment is correct with adjacent tiles and evidence of movement or rocking is eliminated.

g. Chipped, broken and cracked tiles shall be rejected.

h. Deviations exceeding 1/4" (6mm) in 10 ft (3 M Approx) applied in all directions shall not be accepted.

6. APPLICATION OF HEAT INSULATION IN CAVITY WALLS

Heat insulation between two leaves of block wall(s)/concrete surfaces shall be applied as follows:

a. Place insulating sheets/boards vertical against the thicker of the two leaves of the wall before laying of outer leaf of block wall. Insulation of non-horizontal spaces shall be applied horizontally, closely butted, with vertical joints staggered.

b. The application shall begin at the bottom of the wall and work towards the top.

c. Care should be taken not to damage/puncture the sheets while tying the two leaves of the wall together.

7. MEASUREMENT AND PAYMENT

a. Unless otherwise specifically stated in the bill of Quantities or herein, all items shall be deemed to be inclusive of, but not limited to the following:-

I. Contractor’s establishment charges, overhead charges, profit, interest.

ii. All other expenses, charges, taxes specified in conditions of Contract.

iii. Labour and all costs in connection therewith.

iv. Use of plant, equipment and machinery and all costs in connection therewith, e.g. mobilization, demobilization, transporting, fuel, energy charges, grease

oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand, parking, removing, damaged, destroyed, salvage.

v Material and goods e.g. marketing, selecting, conveyance, loading, un-loading, storing, watching, returning, handling, hoisting, lowering, cutting, joining, fixing, wastage, destroyed, damaged, salvaged.

b. Works shall be measured net as applied in position as per Drawings and instructions of the Engineer. Each measurement shall be taken to the nearest 1/2" (12.5mm). This rule shall not apply to any dimensions stated in descriptions.

c. Water proofing and Heat Insulation, except where otherwise stated shall be measured as the net actual visible area of the treated surface in sq. ft (square meters) describing the quality.

d. Rate for each item of treatment/application i.e. screed, water proofing, insulation and clay tiles floor finishes shall be stated separately.

e. Rates for water proofing under RCC or Plain slab on grade shall be quoted separately.

g. Unit rate for water proofing and heat insulation shall be deemed to be inclusive of all preparatory work, scrapping, scratching, cleaning, priming and the like, complete as directed by the Engineer.

h. Unit rate for water proofing and built-up roofing shall be deemed to be inclusive of nailing strips, cant strips, gravel strips, flashings, scuppers, roof drains, grouting of precast panel joints, turn-ups, turn-downs and wedging of felt, laps of felt and the like if specified, complete as directed by the Engineer.

Section - 6

TERMITE CONTROL

1. SCOPE

The work covered by this section of Specification consists of furnishing all labour, materials, equipment, services, miscellaneous and necessary items required to complete Termite Control and, related works as indicated on drawings, and specified herein, in strict accordance with this section of specifications, as subject to the terms and conditions of the Contract.

2. MATERIALS

a) Pesticides shall be 0.4% Termidor and/or as directed by the manufacturer, or solution of 0.5% Dieldrin or a 0.5% Aldrin, mixed in clean water for application in earth, and mixed in pure turpentine for application to wood.

b) Pesticides (Dieldrin & Aldrin) shall be obtainable from the Government of Pakistan, Department of Agriculture, or other sources approved by Engineer in sealed drums at rates in force at the time of their acquisition and only in the quantity necessary for work of this Project. All mixing shall be done at site and the amount of pesticides used shall be verified by the Engineer.

3. METHOD OF APPLICATION

Pesticides solution shall be applied with approved pressure spraying equipment maintaining a pressure of 150, p.s.i. (10.5kg/cm$^{2)}$ to all application to, on or in earth. Spraying to wood shall be done by hand compression with an approximate pressure of 20 p.s.i.

4. WORKMANSHIP

The treatment operation shall be carried out as follows:-

a) After the excavation for foundation trenches and pits is completed in each and every respect, and passed for concreting work, but before laying of concrete, Pesticide shall be penetrated to a depth of 1” (25 mm) ;minimum in porous earth at bottom and 2” (50mm) to 3” (75 mm) at sides of excavation.

b) Stock piled excavated material to be used as back fill is to be treated as above. After backfilling to required grade the area is again to be sprayed.

c) After grading, compaction and levelling of fill and before installation of any soling, all areas are to be sprayed with pesticide, penetrating a minimum of 1” (25mm) into soil.

d) Pesticide solution shall be applied inside the building lines and for a distance of 10 feet (3 M) out side all building with specified pressure.

e) All rough wood work for the entire project is to be pesticide treated (before application of Soligum in the case of material to receive both treatments). Pesticide shall be sprayed on all surfaces of all the wooden work viz, door frames blocking, furring, planks,, boards etc, before installation. No spraying shall be necessary after field sawing, planning, joining or installation of such material. All spraying will be done within one week of working of the materials.

5. LOCATION AND SCHEDULING

a) Saturation of earth is to be done by adequate personnel and in such a manner as to in no way disrupt the progress of the work.
b) Such work is to be scheduled and done by sufficient skilled personnel manner as to in no way impede the progress of the work.
c) Care shall be exercised to ensure that no mark or damage occurs to the finished building as a result of the work under this section, and Contractor shall verify and ensure that no material used herein will impede the growth of grass or plants at areas where spraying is done.

6. STANDARDS

All methods of termite protections used herein be in accordance with best standard practices of National Pest Control Association, U.S.A. and the British Wood Preserving Association.

7. GUARANTEE

The Contractor is to guarantee that the building shall be free from termites (white ants), wood bores and other pests or rodents which cause damage to wood or other organic material for 10 years from the date of acceptance of the building.

In the event of any damage caused within the guaranteed period, the Contractor shall replace at his own cost such damage material, finishes affected and suitably preserve and treat the entire premises with the best method known to the trade to prevent the spreading of termites.

8. TESTING

All materials and samples shall be subject to testing in accordance with the relevant standards specified herein, and shall be rejected if found below these standards. Rejected materials shall be removed from the site immediately; Contractor shall quote a lump sum rate for the termite control testing and treatment of the ground and excavation covered by this specifications including all ditches, pits, excavations, wood etc., complete.

9. MEASUREMENT & PAYMENT

a) Unless otherwise specifically stated in the Bill of Quantities or herein, all the work involved within the scope of this section of specification shall be deemed to be inclusive of but not limited to the following:-

i) CONTRACTOR's establishment charges, overhead charges, profit, interest.
ii) All other expenses, charges, taxes specified in the Conditions of CONTRACT.
iii) Labour and all costs in connection therewith.
iv) Use of plant, equipment and machinery and all costs in connection therewith, e.g. mobilizations, demobilization, transporting, fuel, energy charges, grease, oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand parking, removing, damaged, destroyed, salvaged.
v) Material and goods, e.g. marketing, selecting, conveyance, loading, unloading, storing, watching, returning, handling, hoisting, lowering cutting, joining fixing, wastage, destroyed, damaged, salvaged.

b) The cost of all the works involved within the scope of this specification as per all the Drawings and Conditions of CONTRACT are covered only within the quoted lump sum rate of the item of the Bill of Quantities.

c) No separate payment will be made for wood work etc. Covered under this section of the specifications, and all cost in connection therewith shall be included in the unit rates of the various items of the wood work affected by treatment.

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SECTION 1 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 USE OF SITE

A. **General**: The Contractor shall have full use of the site of the works, during construction period. However, the Contractor's use of site is limited only by the Employer's right to perform work or to retain other Contractors to do so.

B. **Use of Site**: Limit work and activities to the area of the Site as defined on Drawings in areas indicated. Do not disturb areas outside the Site or in which the work is indicated.

1. Limits: Confine constructions operations to areas where work is permitted.

2. The Employer Occupancy: Allow for the Employer occupancy of Site.

3. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to the Employer, the Engineer and their employees, other Contractors engaged in work on the Site and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.

    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.3 OCCUPANCY REQUIREMENTS

A. **Partial Employer Occupancy**: The Employer reserves the right to occupy and to place and install equipment in completed areas of the Site, before substantial completion, provided such occupancy does not interfere with the Contractor's completion of the Works. Such placement of equipment and partial occupancy shall not, by itself, constitute completion or acceptance, or Taking-Over of any part of the Works.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT

SECTION 2 - QUALITY ASSURANCE/ QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 QUALITY ASSURANCE PROGRAM

A. Provide and maintain an effective Quality Assurance Program that complies with Clauses 36, 37, 38 and 39 entitled "Materials, Plant and Workmanship" of the Part I, General Conditions of the Contract.

1.3 SCOPE OF PROGRAM

A. The Contractor shall establish a Quality Assurance Program to perform sufficient inspection and tests of all items of work, including that of his suppliers and subcontractors, to insure conformance to applicable Technical Specifications and Drawings with respect to the materials, workmanship, construction, finish, functional performance, and identification.

1.4 PLAN DEFINITION

A. **The PQAP (Project Quality Assurance Program)**: This Plan is the means to ensure that construction complies with the requirements of the Contract Documents. The CQAP shall be adequate to cover all construction operations, including both on-site and off-site fabrication and installation works by subcontractors and will be keyed to the proposed Contract Schedule. The PQAP shall include as a minimum, at least three phases of inspection for all definable phases of works which are subsequently described in paragraphs 1.4.B, 1.4.C, 1.4.D.

B. **Preparatory Inspection**: This inspection shall be performed prior to beginning any work on any activity on any definable phase of works and as shown in the Contract Schedule. It shall include a review of contract requirements; a check to assure that all materials and/or equipment have been tested, submitted, and approved by the Engineer; a check to assure that provisions have been made to provide required control testing; and plan mock-ups when appropriate; examination of work area to ascertain that all preliminary work has been completed; and a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand. The Engineer shall be notified at least twenty four (24) hours in advance of the preparatory inspections and such inspection shall be made a matter of record in the Contractor's Quality Control Reports as required by paragraph 3.3.

C. **Initial Inspection**: This inspection shall be performed as shown in the Contract Schedule. This inspection shall occur as soon as a representative portion of the particular phase of construction has been accomplished. This shall establish the acceptable standard of workmanship, including a review of control testing for compliance with contract requirements, review of mock-up, use of defective or damaged materials, omissions, and dimensional requirements. The Engineer shall be notified at least twenty four (24) hours in advance of the initial inspection and such inspection shall be made a matter of record in the Quality Control Reports as required by paragraph 3.3.

D. **Follow-up Inspections**: Inspections shall be performed daily to assure continuing compliance with Contract requirements, including control testing, until completion of the particular phase of construction. Such inspections shall be made a matter of record in the Quality Control Reports as required by paragraph 3.3.

1.5 CONDITIONS OF PROJECT QUALITY ASSURANCE PROGRAM (PQAP)

A. Furnish to the Engineer, a PQAP which shall include the personnel, instructions, procedures, records to be used, document controls and quality assurance overview. This document will include as a minimum:

a. The Quality Control Organization (Chart) including major reporting lines and relationships.

b. Reporting relationships within and external to organization. Duties and responsibilities within the said organization shall be stated.

c. The name of the Quality Control Manager (QCM). This individual shall report directly to senior management, independent of manufacturing/ construction.

d. Names and Qualifications of Quality Control Personnel.

e. Authority and area of responsibilities of Quality Control Personnel.

f. An explanation as to how the Quality Control organization relates to other staff elements as regards Shop drawing submittals, As-Built drawings, revisions to the contract and safety.

g. Methods proposed to control the use of the various design documents, shop drawings, procedures, etc. to assure that only the latest reviewed documents are used and are distributed to the individuals performing the Work. Recall of documents which have been superseded or revised shall be implemented. Describe the process used to determine what submittals are required by the Contract and the system used to track these submittals and their current status.

h. A narrative discussion of how the Quality Control staff will accomplish the tasks assigned to quality control.

i. A copy of a letter of direction to each representative responsible for Quality Control, outlining his duties and responsibility and signed by a responsible officer.

j. Identification and description of all mock-up items.

k. Methods for accomplishing quality control inspections addressing the how, what, where, when and why of these inspections, including that for subcontractor's work (see paragraph 3.).

l. Method of documenting quality control operations, inspections and testing. This shall include how various records originated and maintained, received, filed, protected, and authenticated. Quality Records required for submittal to the Engineer shall be described.

m. Detailed listing by Specification Section and paragraph designating all QC requirements and tests to be performed and their frequency. Further indicate which tests will be performed by technicians or by an approved testing laboratory.

n. Methods to be employed when any Work is found not to meet Technical Specifications and the means to be implemented to document the items (non-conformance reports) and provide resolution.

o. A matrix of all Contract and Technical Specification requirements to enable monitoring of all items from start until acceptance and completion. This is to facilitate Contract close-out.

B. To facilitate contract management and project administration the Contractor shall acquire and implement the Primavera Expedition Project Control system. The Contractor shall provide information on tracking and control of documentation extracted from the System as and when required by either the employer or the Engineer.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Prior to submittal of the PQAP for acceptance, meet with the Engineer or his representative and discuss the PQAP. The meeting shall develop mutual understanding relative to details of the system, including the forms to be used for recording the Quality Control operations, inspection, administration of the program, and the interrelationship and the Engineer's inspection. Requirements for Hold

Point Release sign offs on Quality Control checklists/ inspection sheets by the Engineer shall also be discussed and established.

3.2 QUALITY CONTROL ORGANIZATION

A. The PQAP shall be implemented by the establishment of the Quality Control Organization whose sole duty will be to ensure conformance to the Contract of all QA/QC activities.

B. Quality Control Manager (QCM) must be an individual with demonstrated experience implementing a QC program and supervising Inspectors.

1. This experience shall include at least five (5) years of Quality Control (QC) background in any combination of the following areas:

   a. Field inspection.

   b. Construction phase experience relevant to the scope of work.

   c. Previous experience as a Quality Control Manager.

   d. Fabrication/Manufacturing experience.

2. In addition, the QCM shall have the following managerial experience:

   a. Supervised at least two (2) people.

   b. Experience on a government regulated project.

   c. Implemented a Quality Control (QC) program.

   d. Experience on a comparably sized project of similar complexity.

3. Submit the résumé of proposed QCM for acceptance by the Engineer. If, for any reason, the QCM is replaced, the resume of the proposed replacement QCM shall be submitted and accepted by the Engineer prior the replacement taking effect.

4. Due to the complexity and nature of this Contract a full time QCM is required.

C. Quality Control Organization shall be sufficiently staffed to perform the following tasks:

1. Conduct phased inspections (Preparatory, Initial and Follow-up) in accordance with paragraph herein before.

2. Perform all testing required under the Technical Specifications, including all listed Codes and Standards.

3. Prepare daily and monthly QC reports in accordance with paragraph 3.3 hereinafter.

4. Review and endorse all shop drawing submittals for compliance with Contract requirements prior to submission to the Engineer.

5. Inspect materials as they are delivered on site to ensure compliance with reviewed shop drawings and contract specifications.

6. Conduct off-site inspections of supplies and services to be incorporated into the work. Provide monthly report of off-site QC activities.

7. Maintain record of all QC activities. These records shall be available for the Engineer's use.

D. Where applicable and as a minimum, the Quality Control staff shall include the following suitably qualified personnel:

1. Structural Quality Control Inspector

2. Architectural Quality Control Inspector

E. If at any time during the contract period the Engineer determines the Contractor's Quality Control staff is not capable of performing all the tasks listed above, then the Engineer may direct to revise and/or supplement the present organization structure at own cost.

3.3 QUALITY CONTROL REPORTS

A. **Daily Quality Control Report**: Submit a daily Quality Control Report. The report shall contain a record of inspections and tests for all work accomplished subsequent to the previous report and shall include the following information:

1. Phase(s) of construction underway during the time frame of the report. (i.e. earthwork, concrete work, structural steel erection, mechanical and electrical installations, architectural finishes etc.)

2. Phase Inspection (preparatory, initial or follow-up), phase of construction and location of inspections and/or tests that were made.

3. Results of inspection, including nature of deficiencies observed and corrective actions taken or to be taken.

4. Report of tests performed, including those specified, with the results of the tests, including failures and remedial action to be taken. Test results, including all computations shall be attached to the report form. Where test results cannot be completed by the time the report is submitted, a notation shall be made that the test was performed and the approximate date test

results will be available. Delayed test results shall be submitted with the report form on the date received.

5. Results of inspection of materials and equipment upon arrival at the site and prior to incorporation into the work for compliance with submittal approvals, damage and proper storage.
6. Offsite QA/QC activities.
7. Instructions received from the Engineer.
8. All non-conformances, either in tests or inspections, shall be specifically listed under a separate heading.
9. In all cases, the report must be verified and signed by QCM. The verification is to contain the statement that all supplies and materials incorporated in the work are in compliance with the Contract except as noted.

B. **Monthly Quality Control Report**: Submit a Monthly Quality Control Report. This report shall consist of an executive summary of all QA/QC activities executed in the previous month. The report shall contain the following information:

1. Phase(s) of construction underway during the time frame of the report. (i.e. earthwork, concrete work, structural steel erection, mechanical and electrical installations, architectural finishes etc.)
2. Confirmation that all necessary Quality Control testing has been performed in accordance with the Technical Specifications and other Contract documents, with respect to quantity and quality.
3. Summary of the tests performed during the month, including number passing and failing.
4. Summary of all non-conformances, including actions taken or actions proposed.
5. Details of significant trends in test results.
6. In all cases, the report must be verified and signed by QCM. The verification is to contain the statement that all supplies and materials incorporated in the work are in compliance with the Contract except as noted.

3.4 CHANGES TO QUALITY ASSURANCE PROGRAM

A. Notify the Engineer or his authorized representative in writing of any proposed change to the Contractor's Quality Assurance Program. Any proposed changes must not be implemented until prior approval has been received from the Engineer.

END OF DOCUMENT

SECTION 3 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1. Refer to Conditions of Contract and Agreement for definitions and specific dates of Contract Time.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Programme.
2. Construction Programme.
3. Submittals Schedule.
4. Daily construction reports.
5. Monthly progress reports.
6. Material location reports.
7. Field condition reports.
8. Accident reports.
9. Special reports.
10. Wage book and time sheet records.

B. Related Sections include the following:

1. Division 1 Section "Summary of Multiple Contracts" for preparing a Combined the Contractor's Construction Programme.
2. Division 1 Section "Project Management and Coordination" for distributing meeting and conference minutes.
3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.
5. Division 2 Sections for specific submittal requirements.

1.3 DEFINITIONS

A. **CPM**: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

B. **Critical Path**: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

C. **Network Diagram**: A graphic diagram of a network schedule, showing activities and activity relationships.

D. **Activity**: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction programme consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.

2. Predecessor activity is an activity that must be completed before a given activity can be started.

E. **Event**: The starting or ending point of an activity.

F. **Float**: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Party, but is a jointly owned, expiring Project resource available to both parties as needed to meet milestones and Contract completion date.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity or activities.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. **Fragment**: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. **Major Area**: A storey of construction, a separate building, or a similar significant construction element.

I. **Milestone**: A key or critical point in time for reference or measurement, including for example, but not necessarily limited to:

1. Commencement Date.

2. Completion dates for specific Sections or parts of the Works.

3. Completion date for the whole of the Works.

1.4 SUBMITTALS

A. **Qualification Data**: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects/engineers and owners, and other information specified.

B. **Submittals Schedule**: Submit three copies of schedule. Arrange the following information in a tabular format, identifying corresponding programme activity or event number for each scheduled date:

1. Scheduled date for first submittal.

2. Specification Section number and title.

3. Submittal type and category (action or informational).

4. Name of manufacturer and/or subcontractor, as applicable.

5. Description of the work covered.

6. Scheduled date for the Engineer's final release or approval.

7. Scheduled dates for Purchase Order and first delivery to Project site.

8. Scheduled date for commencement of installation.

C. **Update Submittals Schedules**: Submit two copies of update schedules.

D. **Construction Programme**: Submit two blue- or black-line print copies of programme, large enough to show entire programme for entire construction period. In title block indicate "Initial", "Revised" or "Update" as applicable, and date of issue.

1. Submit an electronic copy of programme, using software indicated, on CD-ROM labeled to comply with requirements for submittals. Indicate type of programme (Initial, Revised or Update) and date on label.

E. **CPM Reports**: Concurrent with each CPM schedule submittal, submit three printed copies of each of the following corresponding, computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.

1. Activity Report: List of all activities sorted by major area, then by activity number and then early start date, or actual start date if known.

2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.

3. Total Float Report: List of all activities sorted in ascending order of total float.

4. Resource Allocation and Loading Report: List of all resources allocated to schedule activities, sorted in ascending order by activity number and then early start date, or actual start date if known, including but not necessarily limited to:

   a. Number and trade classification of workmen.

   b. Quantities of materials and products.

   c. The Contractor's Equipment.

5. Monetary Value Summaries.

F. **Construction Photographs**: Submit two (2) print sets of each photographic view within five (5) days of taking photographs.

1. Format: 200 x 250-mm smooth-surface matte colour prints on single-weight commercial-grade stock, enclosed back to back in clear plastic sleeves that are punched for standard ring binder.

2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:

   a. Name of Project.

   b. Name of the Employer.

   c. Name of the Engineer.

   d. Name of the Contractor.

   e. Date photograph was taken.

   f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction, as applicable.

3. Negatives: Submit a complete set of corresponding photographic negatives, in protective envelopes, with each submittal of prints. Identify date photographs were taken.

   a. Negatives shall be for the Employer's free and unrestricted use.

G. Daily Construction Reports: Submit two (2) copies daily, and no later than 4:00 pm on the day immediately following date of report.

H. **Monthly Progress Reports**: Submit two (2) copies at monthly intervals. Report progress status coincidental with cutoff date associated with each Monthly Statement payment application.

1. Submit an electronic copy, using Microsoft Office software, on 90-mm diskette(s) labeled to comply with requirements for submittals.

I. **Material Location Reports**: Submit two (2) copies at weekly intervals.

J. **Field Condition Reports**: Submit two (2) copies at time of discovery of differing conditions.

K. **Accident Reports**: Submit two (2) copies at time of accident event.

L. **Special Reports**: Submit two copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. **Scheduling Consultant Qualifications**: An experienced specialist in CPM scheduling and reporting.

B. **Photographer Qualifications**: An individual of established reputation who has been regularly engaged as a professional photographer for not less than three years.

C. **Computer Software**: Use a professional, high-end, reputable project management software program, acceptable to the Engineer that has been developed specifically to manage CPM construction programming, scheduling and reporting indicated for Project.

D. **Pre-scheduling Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Programme and the Contractor's Construction Programme, including, but not necessarily limited to the following, as appropriate:

1. Review software limitations and content and format for reports.

2. Verify availability of qualified personnel needed to develop and update programme.

3. Discuss constraints, including phases, sections, work sequences, area separations, interim milestones, interface with other contractors, statutory agencies and authorities having jurisdiction; staged completion, partial the Employer occupancy and the like, as applicable.

4. Review programme for work of the Employer's separate contracts.

5. Review time required for review of submittals and re-submittals.

6. Review requirements for tests and inspections by independent testing and inspecting agencies.

7. Review time required for completion and start-up procedures.

8. Review and finalize list of construction activities to be included in programme.

9. Review submittal requirements and procedures.

10. Review procedures for updating programme.

1.6 COORDINATION

A. Coordinate preparation and processing of programmes, schedules and reports with performance of construction activities and with programming, scheduling and reporting of separate contractors.

B. Coordinate Construction Programme with the list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Works from parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. **Auxiliary Services**: Cooperate with photographer and provide auxiliary services requested, including access to Site and use of temporary facilities including temporary lighting.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. **Preparation**: Arrange Submittals Schedule in chronological order by dates required by construction programme. Include time required for review, re-submittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts and the Contractor's Construction Programme.

2. Submittal: Submit concurrently with the submittal of completed the Contractor's Construction Programme. List those required to maintain orderly

progress of the Work and those required early because of long-lead time for manufacture or fabrication.

3. Update Submittals: Continuously update Submittals Schedule to reflect actual and on-going current status, including additions to and changes in timing of submittals. Submit an Update Submittals Schedule on the day before each regular Progress Meeting.

2.2 CONTRACTOR'S CONSTRUCTION PROGRAMME, GENERAL

A. **Arrangement**: Arrange activities on programme by Section and/or major area, as applicable.

B. **Activities**: Treat each building storey and/or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by the Engineer.

2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in programme. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and re-submittal times indicated in Division 1 Section "Submittal Procedures", in programme. Coordinate submittal review times in the Contractor's Construction Programme with Submittals Schedule.

4. Startup and Testing Time: Indicate and include appropriate time allowances for startup and testing of each equipment and system installation.

5. Substantial Completion: Indicate substantial completion in advance of date established for Taking-Over, and allow time for the Engineer's inspection and administrative procedures necessary for certification of Taking-Over.

C. **Constraints**: Include constraints and work restrictions indicated in the Contract Documents and as follows in programme, and show how the sequence of the Work is affected.

1. Work under Multiple Contracts: Include a separate activity for each portion of work performed by each separate contract.

2. Work by the Employer: Include a separate activity for each portion of work performed by the Employer.

3. Work Restrictions: Show the effect of the following items on the programme:

a. Coordination with existing construction.

b. Limitations of continued occupancies.

c. Uninterruptible services.

d. Partial occupancy before substantial completion.

e. Use of premises restrictions.

f. Provisions for future construction.

g. Seasonal variations.

h. Environmental control.

4. Work Stages: Indicate important stages of construction for each major portion of the Works, including, but not limited to, the following:

a. Subcontract awards.

b. Submittals.

c. Purchases.

d. Mock-ups.

e. Fabrication.

f. Sample testing.

g. Deliveries.

h. Installation.

i. Tests and inspections.

j. Adjusting.

k. Curing.

l. Start-up and placement into final use and operation.

5. Area Separations: Identify each major area of construction for each major portion of the Works. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

a. Structural completion.

b. Permanent space enclosure.

c. Completion of mechanical installation.

d. Completion of electrical installation.

e. Substantial completion.

D. **Sectional Completions and Milestones**: Include in programme, milestones and any and all sectional completion requirements, indicated in Contract Documents, including but not necessarily limited to Commencement Date, dates for Taking-Over sections or parts of the Works and date for Taking-Over the whole of the Works.

E. **Cash Flow Correlation**: At the head of programme, provide a cash flow correlation line, indicating on the line, monetary value volume of the Works as planned and as actually performed.

1. Tabulate cash flow correlation, coincidental with cut-off dates associated with Monthly Statement payment applications, and use as a basis for preparation of Cash Flow Estimate submittal.

F. **Contract Variations**: If and when requested by the Engineer in connection with any proposed or instructed Contract Variation, prepare and submit a time-impact analysis, using fragnets if necessary, to demonstrate the effect of the proposed or instructed Variation on the overall construction programme.

G. **Computer Software**: Prepare and update programmes and schedules using the following software program that has been developed specifically to manage construction programming and scheduling.

1. Primavera Project Planner, Latest Version, for Windows NT or Windows XP operating system.

2.3 PRELIMINARY CONSTRUCTION PROGRAMME (BAR-CHART SCHEDULE)

A. **Preliminary Schedule**: Submit preliminary horizontal bar-chart-type or network type construction programme with the Tender in accordance with the requirements of the “Instructions to Tenderers”.

2.4 CONTRACTOR'S CONSTRUCTION PROGRAMME (GANTT CHART)

A. **Gantt-Chart Programme**: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, the Contractor’s Construction Programme within fourteen (14) days after the date of the Letter of Acceptance. Base programme on the Preliminary Construction Programme submitted with Tender and whatever updating and feedback received to date.

B. **Preparation**: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.5 CONTRACTOR'S CONSTRUCTION PROGRAMME (CPM SCHEDULE)

A. **General**: Prepare network diagrams using AON (activity-on-node) format.

B. **CPM Schedule**: Prepare and submit the Contractor's Construction Programme using a CPM network analysis diagram. Base programme on the Preliminary Construction Programme submitted with Tender and whatever updating and feedback received to date. Follow procedures and produce CPM schedule and reports in such form and detail as specified. Incorporate additional requirements, as the Engineer shall reasonably prescribe.

1. Develop, finalize and submit completed CPM schedule and reports for the Engineer's review and acceptance no later than fourteen (14) days after the date of the Letter of Acceptance.

2. Conduct educational workshops to train and inform key personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.

3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with regular Progress Meeting, Monthly Progress Report and Monthly Statement payment application dates.

4. Use "one workday" as the unit of time and indicate number of shifts per workday.

5. Use calendar to identify and indicate holidays and other non-work days.

C. **CPM Schedule Preparation**: Prepare a list of all activities required to complete the Works.

1. Activities: Indicate for each activity, the estimated time duration, sequence requirements, resource requirements, relationship to other activities, and monetary value. Include dates and estimated time frames for the following activities:

a. Preparation and processing of submittals.

b. Purchase of materials.

c. Delivery.

d. Fabrication.

e. Installation.

2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

    a. Use resource-levelling method in computing the CPM schedule.

3. Format: Mark the critical path. Locate the critical path near centre of network; locate paths with most float near the edges.

    a. Sub-networks on separate sheets are permissible for activities clearly off the critical path.

D. **Initial Issue of Schedule**: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. The Contractor or subcontractor and the work or activity.
2. Description of activity.
3. Principal events and constraints of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Calendar for each activity
9. Total float or slack time.
10. Resource allocation and loading of activity.
11. Monetary value of activity (coordinated with Bill of Quantities values).
12. Average size of workforce.
13. Holidays and non-work days

E. **Schedule Updating**: Concurrent with making updates and/or revisions to schedule, prepare (in addition to other specified CPM reports) tabulated reports showing the following:

1. Identification of activities that have changed.

2. Changes in early and late start dates.

3. Changes in early and late finish dates.

4. Changes in activity durations in workdays.

5. Changes in the critical path.

6. Changes in total float or slack time.

7. Changes in usage or availability of resources.

8. Changes in the Contract Time.

9. Indicate actual versus original planned progress.

F. **Monetary Value Summaries**: Prepare cash flow predictions based on indicated activities and include two cumulative value lists, sorted by finish dates.

1. In first list, tabulate the following:

   a. Activity number.

   b. Early finish date.

   c. Monetary value.

   d. Cumulative monetary value.

2. In second list, tabulate the following:

   a. Activity number.

   b. Late finish date.

   c. Monetary value.

   d. Cumulative monetary value.

3. Prepare lists for ease of comparison with Cash Flow Estimates and Monthly Statement payment applications.

4. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.

5. Submit update value summary printouts with each Monthly Statement payment application.

a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.

2.6 REPORTS

A. **Daily Construction Reports**: Prepare a daily construction report, recording the following information concerning events at Project site:

1. List of construction work activities and operations performed on the Works, referenced to locations and CPM schedule activity numbers.
2. List of subcontractors on the Works.
3. List of separate contractors at Site.
4. Count and trade classification of workmen on the Works, allocated to CPM schedule activity numbers.
5. Count, category and status (working, idle, under maintenance) of the Contractor's Equipment at Site, allocated to CPM schedule activity numbers.
6. High and low temperatures and general weather conditions.
7. Accidents (refer to accident reports).
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Variation Orders received and implemented.
15. Site Instructions received.
16. Services connected and disconnected.
17. Equipment or system tests and start-ups.
18. Partial Completions and occupancies.
19. The Engineer's Inspections.

20. Taking-Over Certificates issued.

21. Any other general or specific information, requested by the Engineer to be reported.

B. **Monthly Progress Reports**: Prepare and submit monthly progress reports, summarizing activities, achievements, advancements and significant events at Site in month preceding, and reporting current progress status of Works; including but not necessarily limited to the following:

1. Summary of the information included in Daily Construction Reports for the month.

2. Summary of the information included in Material Location Reports for the month.

3. Latest update Submittals Schedule.

4. Progress Review Statement: Refer to latest Update the Contractor's Construction Programme; include:

   a. Listing of all current month programmed activities and report whether each is on time, ahead of schedule or behind schedule in relation to original the Contractor's Construction Programme.

   b. On-going comparative line plot of Cash Flow Estimate against Interim Payment Certificates.

   c. Description of means, methods and actions to be taken in following month to expedite construction behind schedule and ensure current and subsequent activities will be completed within Time for Completion.

5. Any other general or specific information, requested by the Engineer to be reported.

C. **Material Location Reports**: At intervals indicated, prepare and submit a comprehensive listing, in tabular form, of materials delivered to and stored at Site. List shall be cumulative, showing materials previously reported plus items delivered since previous report. Coordinate reports with information in Product List submitted under Division 1 Section "Product Requirements".

1. Form: Tabulate information for each material delivery under the following column headings:

   a. Delivery date

   b. Specification Section number and title.

   c. Generic name used in the Contract Documents.

d. Proprietary name, model number, and similar designations.

e. Manufacturer's name and address.

f. Supplier's name and address.

g. Delivered quantity.

D. **Field Condition Reports**: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Include a detailed description of the differing conditions, together with a request for instruction, if applicable.

E. **Accident Reports**: On the occurrence of any accident which causes personal injury or damage to the Works or any other property, prepare a detailed accident report and submit directly to the Engineer within one day of occurrence. Include details of date and time, location, prevailing conditions, chain of events and causes leading up to accident, persons involved, response by the Contractor's personnel and result or effect of accident. Obtain and attach witness statements, photographs and sketches as applicable.

1. On the occurrence of an accident or event which causes serious injury to any person, summon emergency services, notify appropriate authorities and inform the Engineer immediately

2.7 SPECIAL REPORTS

A. **General**: Prepare and submit special reports, in an acceptable format, directly to the Engineer within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. **Reporting Unusual Events**: When an event of an unusual and significant nature occurs at Site, whether or not related directly to the Works, prepare and submit a special report. List chain of events, persons participating, response by the Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advice the Engineer in advance when these events are known or predictable.

2.8 WAGE BOOK AND TIME SHEET RECORDS

A. **Wage Books and Time Sheets**: Keep and maintain accurate and proper wage books and time sheets of wages paid to and time worked by all workmen employed by the Contractor and subcontractors at Site. Comply with regulations and requirements, if any, of authorities having jurisdiction. Store wage books and time sheets in field office and make available for the Engineer's inspection and reference during normal working hours. If requested, produce and submit photocopies to the Engineer.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION PROGRAMME

A. **Scheduling Consultant**: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. In-House Option: The Engineer may waive the requirement to engage and retain a consultant if the Contractor can demonstrate, to the Engineer's satisfaction, that he employs skilled and competent personnel with appropriate experience in CPM scheduling and reporting techniques. Submit a request, together with qualification data to demonstrate in-house employee capabilities and experience.

2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. **Update the Contractor's Construction Programmes**: Continuously monitor performance and progress of programmed activities, including submittals, procurement and deliveries, supply and availability of allocated resources, etc. At monthly intervals, update programme to reflect actual progress of construction and activities. Issue and submit update programme and corresponding CPM reports coincidental with each Monthly Statement payment application, unless otherwise directed by the Engineer.

1. As work progresses, indicate Actual Completion percentage for each activity.

2. Revise programme immediately after each meeting or other activity where revisions have been recognized and accepted by the Engineer. Issue and submit revised programme within 3 days of such meetings or activities.

3. Include a report with revised programme that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.

C. **Distribution**: Distribute copies of accepted initial programme to the Employer, separate contractors, and other parties identified by the Contractor with a need-to-know programme responsibility.

1. Post copies in meeting rooms and temporary field offices.

2. Distribute accepted revised programmes to the same parties and post in the same locations. Delete parties from distribution when they have completed their assignments and are no longer involved in performance of construction activities.

3.2 CONSTRUCTION PHOTOGRAPHS

A. **Photographer**: Engage a person capable of taking photographs of a standard acceptable to the Engineer. In the event of the photographs submitted are not of an acceptable standard the Contract shall, on the instructions of the Engineer and at his own cost, engage the services of a qualified commercial photographer to take construction photographs.

B. **Photographic Film**: Medium-format, 60 mm x 70 mm.

C. **Date Stamp**: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.

D. **Preconstruction Photographs**: Before starting construction, take twenty four (24) photographs of Site and surroundings from different vantage points, as directed by the Engineer.

1. Take additional photographs in sufficient number and detail to:

a. Show conditions of existing buildings, structures, site improvements and features on and/or adjacent to Site, accurately recording any physical condition, that might otherwise be misconstrued as damage caused by subsequent demolition or construction operations.

b. Show conditions of existing buildings, structures, assemblies, features or other components scheduled for selective demolition or dismantling, accurately recording physical condition, for subsequent reconstruction, restoration or rehabilitation.

E. **Construction Progress Photographs**: Take a minimum of thirty six (36) photographs monthly, adjusted to coincide with cut-off date associated with each payment application. Photographer shall select vantage points, in consultation with the Engineer and the Contractor, to best show status of construction and rate of progress since last photographs were taken.

1. Field Office Prints: Retain an additional print set of all preconstruction and construction progress photographs in field office at Site, and make available at all times for reference by the Engineer. Identify photographs the same as for those submitted to the Engineer.

F. **Final Construction Photographs**: Take seventy two (72) photographs immediately after date of Taking-Over for the whole of the Works. The Engineer will direct photographer for desired vantage points.

END OF DOCUMENT

SECTION 4 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting:

1. Shop Drawings.

2. Other miscellaneous submittals.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for submitting Coordination Drawings.

2. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including the Contractor's Construction Programme, Submittals Schedule and construction photographs.

3. Division 1 Section "Quality Requirements" for submitting test and inspection reports and Delegated-Design Submittals and for erecting mock-ups.

4. Division 1 Section "Closeout Procedures" for submitting warranties project record documents and operation and maintenance manuals.

5. Division 1 Section "Project Record (As-Built) Documents" for submitting record drawings, documents and data.

6. Division 2 Sections for specific submittal requirements.

1.3 DEFINITIONS

A. **Action Submittals**: Written and graphic information that requires the Engineer's responsive action.

B. **Informational Submittals**: Written information that does not require the Engineer's approval. Submittals may be rejected for not complying with requirements.

C. **Shop Drawings**: Include but are not limited to the following:

1. Setting diagrams.

2. Schedules.

    a. Standard information prepared without specific reference to the Works is not Shop Drawings.

D. Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended.

1. Preparation of Coordination Drawings is specified in Division 1 Section "Project Management and Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.

1.4 SUBMITTAL PROCEDURES

A. **General**: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by the Engineer for the Contractor's use in preparing submittals.

B. **Coordination**: Coordinate preparation and processing of submittals with performance of construction activities.

1. Transmit each submittal sufficiently in advance of performance of related procurement and construction activities, allowing ample time for review and re-submittal if necessary, in order to prevent delays to the Works.

2. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

3. Coordinate transmittal of different types of submittals for related parts of the Works so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. The Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. **Submittals Schedule**: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

D. **Processing Time**: Allow enough time for submittal review, including time for re-submittals, as follows. Time for review shall commence on the Engineer's receipt of submittal.

1. Initial Review: Allow twenty one (21) days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. The Engineer will advise the Contractor when a submittal being processed must be delayed for coordination.

2. Concurrent Review: Where concurrent review of submittals by sub-consultants, the Employer, or other parties is required, allow thirty five (35) days for initial review of each submittal.

3. If intermediate submittal is necessary, process it in same manner as initial submittal.

4. Allow 21 days for processing each re-submittal.

E. **Identification**: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 100 x 125 mm on label or beside title block to record the Contractor's review and approval markings and action taken by the Engineer.

3. Include the following information on label for processing and recording action taken:

   a. Contract name.

   b. The Employer's name.

   c. Date.

   d. Name and address of the Engineer.

   e. Name and address of the Contractor.

   f. Name and address of subcontractor.

   g. Name and address of supplier.

   h. Name and address of manufacturer.

   i. Unique identifier, including revision number.

   j. Number and title of appropriate Specification Section.

k. Drawing number and detail references, as appropriate.

l. Other necessary identification.

F. **Deviations**: Highlight, encircle, or otherwise indicate and identify on submittals, deviations from the Contract Documents.

G. **Additional Copies**: Unless additional copies are required for final submittal, and unless the Engineer observes non-compliance with provisions of the Contract Documents, initial submittal may serve as final submittal.

1. For submittals requiring concurrent review, submit one extra copy in addition to specified number of copies to the Engineer.

2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

H. **Transmittal**: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form attached to a cover letter. The Engineer will discard, without review, submittals received from sources other than the Contractor.

1. Cover Letter: On attached, numbered, separate sheet(s), prepared on the Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by the Engineer on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.

a. Include the Contractor's certification stating that information submitted complies with requirements of the Contract Documents.

2. Transmittal Form: Use a form acceptable to and approved by the Engineer. Provide locations on form for the following information:

a. Contract name.

b. The Employer's name.

c. Date.

d. Destination (To:).

e. Source (From:).

f. Names of subcontractor, manufacturer, and supplier, as applicable.

g. Category and type of submittal.

h. Submittal purpose and description.

i. Submittal and transmittal distribution record.

j. Remarks.

k. Signature of transmitter.

I. **Distribution**: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Permit only final submittals with appropriate approved stamp, or other mark indicating action taken by the Engineer, to be used in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. **General**: Prepare and submit Action Submittals required by individual Specification Sections.

1. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:

a. Initial Submittal: Submit a preliminary single copy of each submittal where selection of options, colour, pattern, texture, or similar characteristics is required. The Engineer will return submittal with options selected.

b. Final Submittal: Submit four (4) copies, unless otherwise indicated. Submit additional copies where copies are required for operation and maintenance manuals. The Engineer will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Record (As-Built) Document.

B. **Shop Drawings**: Produce newly prepared, Contract-specific, information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Include the following information, as applicable:

a. Dimensions; in SI units unless otherwise indicated or directed.

b. Roughing-in and setting diagrams.

c. Schedules.

d. Compliance with specified standards.

e. Notation of coordination requirements.

f. Notation of dimensions established by field measurement.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least A4 size, and no larger than A1 size, unless otherwise approved.

3. Number of Copies: Submit copies of each submittal, as follows:

a. Initial Submittal: Submit one (1) correctable, translucent, reproducible print and one (1) blue- or black-line print. The Engineer will return the reproducible print.

b. Final Submittal: Submit four (4) blue- or black-line prints, unless otherwise indicated. Submit additional prints where prints are required for operation and maintenance manuals. The Engineer will retain three (3) prints; remainder will be returned. Mark up and retain one returned print as a Record (As-Built) Drawing.

C. **Coordination Drawings**: Comply with requirements in Division 1 Section "Project Management and Coordination."

D. **The Contractor's Construction Programme**: Comply with requirements in Division 1 Section "Construction Progress Documentation".

E. **Submittals Schedule**: Comply with requirements in Division 1 Section "Construction Progress Documentation."

F. **Subcontract List**: Prepare and submit a list identifying subcontractor individuals or firms proposed for principal portions of the Works, including those who are to fabricate products or equipment to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract.

2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

A. **General**: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. The Engineer will not return copies.

2. Certificates and Certifications: Provide a notarized statement that includes signature of the Contractor, testing agency, or design professional responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of the company.

3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."

B. **Qualification Data**: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects/engineers and employers, and other information specified.

C. **Material Certificates**: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.

D. **Material Test Reports**: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

E. **Preconstruction Test Reports**: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.

F. **Compatibility Test Reports**: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

G. **Field Test Reports**: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

H. **Product Test Reports**: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation

of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW AND APPROVAL

A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to the Engineer.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Contract name and location, submittal number, Specification Section title and number, name of reviewer, date of the Contractor's approval, and statement certifying that submittal has been reviewed, checked, coordinated and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. **General**: The Engineer will not review submittals that do not bear the Contractor's approval stamp and will return them without action.

B. **The Engineer's Action**: The Engineer's review is limited only to checking conformance with information given and the design concept expressed in the Contract Documents. It is not conducted for the purpose of determining the accuracy and completeness of details, dimensions or quantities, nor substantiating integrity or compatibility, nor confirming instructions for installation or performance. The Engineer's approval does not in any way relieve the Contractor of responsibility for compliance with specified provisions and the Contract Document requirements.

C. **Action Submittals**: The Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it to the Contractor. The Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:

1. Final Unrestricted Release: Where the submittal is marked "APPROVED", the work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance of the work will depend on that compliance.

2. Final-but-Restricted Release: Where the submittal is marked "APPROVED AS NOTED", the work covered by the submittal may proceed provided it complies with both the Engineer's notations and corrections on the submittal and the Contract Documents. Final acceptance of the work will depend on that compliance.

3. Returned for Re-submittal: Where the submittal is marked "NOT APPROVED, REVISE AND RESUBMIT", do not proceed with the work covered by the submittal, including purchase, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to the Engineer's notations and corrections.

4. Rejected: Where the submittal is marked "NOT APPROVED, RESUBMIT" or "REJECTED", do not proceed with the work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.

D. **Informational Submittals**: The Engineer will review each submittal and will not return it, or will reject and return it if it does not comply with requirements.

E. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF DOCUMENT

SECTION 5 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit the Contractor's quality control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for the Contractor to provide quality control services required by the Engineer, the Employer, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Divisions 2 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. **Quality Assurance Services**: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. **Quality Control Services**: Tests, inspections, procedures, and related actions performed during and after execution of work, by the Contractor, testing agencies or authorities having jurisdiction, to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by the Engineer.

C. **Testing Agency**: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.4 SUBMITTALS

A. **Qualification Data**: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. **Schedule of Tests and Inspections**: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

C. **Tests and Inspection Reports**: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the work and test and inspection method.
7. Identification of product and Specification Section.

8. Complete test or inspection data.

9. Test and inspection results and an interpretation of test results.

10. Ambient conditions at time of sample taking and testing and inspecting.

11. Comments or professional opinion on whether tested or inspected work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.

13. Recommendations on retesting and re-inspecting.

D. **Permits, Licenses, and Certificates**: For the Employer's records, submit copies of permits, licenses, certifications, inspection reports, releases, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the work.

1.5 QUALITY ASSURANCE

A. **Fabricator Qualifications**: A firm experienced in producing products similar to those indicated in the Contract Documents and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. **Factory Authorized Service Representative Qualifications**: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated in the Contract Documents.

C. **Specialists**: Certain sections of the Specifications may require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

D. **Testing Agency Qualifications**: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.

1.6 QUALITY CONTROL

A. **The Employer Responsibilities**: Where quality-control services are indicated as the Employer's responsibility, the Employer will engage a qualified testing agency to perform these services.

1. The Employer will furnish the Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.

2. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to the Contractor.

B. **The Contractor Responsibilities**: Unless otherwise indicated, provide quality control services specified and required by authorities having jurisdiction.

C. **Manufacturer's Field Services**: Where indicated, engage a factory authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

D. **Retesting/Re-inspecting**: Regardless of whether original tests or inspections were the Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction of revised or replaced work that failed to comply with requirements established by the Contract Documents.

E. **Testing Agency Responsibilities**: Cooperate with the Engineer and the Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify the Engineer and the Contractor promptly of irregularities or deficiencies observed in the work during performance of its services.

2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through the Contractor.

4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Works.

5. Do not perform any duties of the Contractor.

F. **Associated Services**: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Site / work.

2. Incidental labour and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

4. Facilities for storage and field-curing of test samples.

5. Preliminary design mix proposed for use for material mixes that require control by testing agency.

6. Security and protection for samples and for testing and inspecting equipment at Project site.

G. **Coordination**: Coordinate sequence of activities to accommodate required quality assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. **Schedule of Tests and Inspections**: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 28 days of Commencement Date.

1. **Distribution**: Distribute schedule to the Employer, the Engineer, testing agencies, and each party involved in performance of portions of the Works where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. **General**: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality control service activities.

C. Repair and protection are the Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF DOCUMENT

SECTION 6 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. **General**: Basic contract definitions are included in the Conditions of the Contract.

B. **"Approved"**: The term "approved", when used in conjunction with the Engineer's action on the submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.

C. **"Directed"**: Terms such as "directed", "requested", "authorized", "selected", "approved", "required", and "permitted" mean directed by the Engineer, requested by the Engineer, and similar phrases.

D. **"Furnish"**: The term "furnish" means to supply and deliver to the Site, ready for unloading, unpacking, assembly, installation, and similar operations.

E. **"Indicated"**: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings; or to other paragraphs or schedules in the Specifications and similar requirements in the Contract Documents. Terms such as "shown", "noted", "scheduled", and "specified" are used to help the user locate the reference. Location is not limited.

F. **"Install"**: The term "install" describes operations at the Site including the actual unloading, temporary storage, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

G. **"Installer"**: The term "installer" means the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, who performs a particular construction activity including installation, erection, application, or similar operations. Installers shall be experienced in the operations they are engaged to perform.

1. "Experienced": The term "experienced", when used with the term "installer", means having successfully completed a minimum of 5 previous projects similar in size and scope to the Works; being familiar with the special requirements indicated; and having complied with requirements of authorities having jurisdiction.

2. Trades: Using terms such as "carpentry" does not imply that certain construction activities shall be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

3. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities will be performed by specialists who are recognized experts in those operations. The specialists shall be engaged for those activities, and their assignments are requirements over which the Contractor has no option. However, the ultimate responsibility for fulfilling contract requirements remains with the Contractor.

   a. This requirement shall not be interpreted to conflict with enforcing building codes and similar regulations governing the Works. It is also not intended to interfere with local trade-union jurisdictional settlements and similar conventions.

H. **"Provide"**: The term "provide" means to furnish and install, complete and ready for the intended use.

I. **"Regulations"**: The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Works.

J. **"Testing Agencies"**: The term "testing agency" means an independent entity engaged to perform specific inspections or tests, either at the Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. **Specification Content**: These Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be interpolated as the sense requires. Singular words shall be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood shall be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that shall be fulfilled indirectly by the Contractor or by others when so noted.

    a. The words "shall", "shall be", or "shall comply with", depending on the context, are implied where a colon (:) is used within a sentence or phrase.

    b. The word "per" means "in accordance with", "according to", "in compliance with", "complying with", and similar phrases.

1.4 INDUSTRY STANDARDS

A. **Applicability of Standards**: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. If requested by the Engineer, the Contractor shall submit the equivalent to any standard referred to in the Specifications and the Contractor shall convert the parameters mentioned in the specifications to be comparable with the equivalent standard.

C. **Publication Dates**: Unless otherwise indicated, comply with the standards in effect as of the date of the Contract Documents.

D. **Conflicting Requirements**: Where compliance with 2 or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different but apparently equal to the Engineer for a decision before proceeding.

    1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the Engineer for a decision before proceeding.

E. **Copies of Standards**: Each entity engaged in construction on the Project shall be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source and make them available on request.

F. **Abbreviations and Acronyms**: Trade association names and titles of general standards are frequently abbreviated. Where an abbreviation or acronym, as referred to in the Tender Documents, is not understood or recognized by the tenderers they shold seek clarification of same from the Engineer prior to the submission of their tenders.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

(Not Applicable)

END OF DOCUMENT

SECTION 7 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.

B. Temporary utilities include, but are not limited to, the following:

1. Sewers and drainage.
2. Water service and distribution.
3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.
4. Heating and cooling facilities.
5. Ventilation and humidity control.
6. Electric power service and distribution.
7. Lighting.
8. Telephone service and facilities.

C. Support facilities include, but are not limited to, the following:

1. Temporary roads and paving.
2. Dewatering facilities and drains.
3. Identification of the Works and temporary signs.
4. Waste disposal facilities.
5. Temporary Site offices.
6. Storage and fabrication sheds.
7. Temporary stairs.

8. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities include, but are not limited to, the following:

1. Environmental protection.

2. Storm-water control.

3. Tree and plant protection.

4. Site enclosure fence.

5. Security enclosure and lockup.

6. Barricades, warning signs, and lights.

7. Covered walkways.

8. Temporary enclosures.

9. Temporary partitions.

10. Fire protection.

E. Related Sections include the following:

1. Division 1 Section "Summary of Multiple Contracts" for responsibilities for temporary facilities and controls.

2. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.

3. Division 1 Section "Execution Requirements" for progress cleaning requirements.

4. Division 2 Section "Dewatering" for disposal of ground water at Project site.

5. Divisions 2 through 16 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. **Permanent Enclosure**: As determined by the Consultant, permanent or temporary roofing is complete, insulated, and weather tight; exterior walls are insulated and weather tight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. Sewer Service: Pay sewer service use charges for sewer usage, by all parties engaged in construction, at Site.

B. Water Service: Pay water service use charges, whether metered or otherwise, for water used by all entities engaged in construction activities at Site.

C. Electric Power Service: Pay electric power service use charges, whether metered or otherwise, for electricity used in construction activities at Site.

D. Telephone Service: Pay telephone service use charges, for telephones installed at Site.

1.5 SUBMITTALS

A. Implementation and Termination Schedule: Within 14 days of date established for submittal of Contractor's Construction Programme, submit a schedule indicating implementation and termination of each temporary utility.

B. **Temporary Utility Reports**: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

C. Temporary Utilities: Submit detailed proposals including drawings and product data as requested; obtain the Consultant's approval prior to purchase, delivery, installation or implementation, as applicable, of the following:

1. Sewers and drainage.

2. Water service and distribution.

3. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.

4. Electric power service.

5. Telephone service.

D. **Support Facilities**: Submit detailed proposals including drawings and product data as requested; obtain the Consultant's approval prior to purchase, delivery, installation or implementation, as applicable, of the following:

1. Temporary roads and paving.

2. Dewatering facilities and drains.

3. Identification of the Works and temporary signs.

4. Temporary Site offices.

5. Storage and fabrication sheds.

6. Construction aids and miscellaneous services and facilities:

   a. Exterior scaffold system, including ladders, walkways, platforms and guardrails.

   b. Protective screens and chutes.

   c. Tower cranes.

   d. Lifts and hoists for materials and workmen.

E. **Security and Protection Facilities**: Submit detailed proposals including drawings and product data as requested; obtain the Consultant's approval prior to purchase, delivery, installation or implementation, as applicable, of the following:

1. Site enclosure fence.

2. Covered walkways.

3. Fire protection.

1.6 QUALITY ASSURANCE

A. **Regulations**: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:

1. Building code requirements.

2. Health and safety regulations.

3. Utility company regulations.

4. Police and fire department regulations.

5. Environmental protection regulations.

B. **Tests and Inspections**: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 CONDITIONS

A. Temporary Utilities: At earliest feasible time, when acceptable to the Consultant, change over from use of temporary service to use of permanent service.

B. Temporary Use of Permanent Facilities: The Contractor shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Taking-Over, regardless of previously assigned responsibilities.

1. Contractor's personnel and workmen, including subcontractors, are not permitted to use permanent toilet facilities or wash facilities.

C. **Conditions of Use**: The following conditions apply to use of temporary services and facilities by all parties engaged in the Works:

1. Keep clean and neat.

2. Operate in a safe and efficient manner.

3. Do not overload or permit them to interfere with progress.

4. Take appropriate fire prevention measures.

5. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisance to develop or persist on Site.

6. Relocate as required by progress of the Works.

PART 2 - PRODUCTS

2.1 MATERIALS

A. **General**: Provide new materials suitable for use intended. Undamaged, previously used materials in serviceable condition may be used for temporary facilities if approved by the Consultant.

B. **Construction Materials and Products**: Comply with standards and applicable requirements in appropriate Sections of the Specification.

C. **Tarpaulins**: Waterproof, fire-resistive, with low flame-spread rating.

D. **Temporary Enclosures**: Translucent, fire-retardant, nylon-reinforced laminated polyethylene or polyvinyl chloride tarpaulins.

E. **Water**: Clean, fresh, potable.

2.2 EQUIPMENT

A. **General**: Provide new equipment suitable for use intended. Undamaged, previously used equipment in serviceable condition may be used for temporary facilities if approved by the Consultant. Refer to Appendices 1 and 2 herein for the requirements.

B. **Temporary Site Offices**: Prefabricated, mobile units or job-built construction, with lockable entrances, operable windows, serviceable finishes and robust and secure fittings; insulated, weather-tight, heated and air-conditioned.

1. Incorporate sanitary facilities to the extent required for the number and gender of personnel accommodated.

2. Support on foundations adequate for loading.

3. Provide and maintain all necessary and required services and utilities, including but not necessarily limited to:

   a. Sewers and drainage.

   b. Water service and distribution.

   c. Sanitary facilities, including toilets, wash facilities, and drinking-water facilities.

   d. Air-conditioner heating and cooling.

   e. Ventilation.

   f. Electric power service.

   g. Lighting.

   h. Telephone service.

   i. Firefighting appliances.

   j. Janitorial services and facilities, and general attendance.

4. Consultant's and Employer's Site Offices: Provide new office furniture and equipment suitable for use intended. If acceptable to the Consultant, the Contractor may provide undamaged, previously used furniture and equipment in serviceable condition, to the extent approved by the Consultant.

C. **Computers for the Consultant**: New computer equipment and peripheral hardware, licensed software, Internet connection and associated accessories, including local area networking, computer workstation desking, and all necessary cabling as required.

1. PC: Core 2 Duo CPU, 2.33 GHz 2.33 GHz; 4 GB Mb Ram; 60 Gb Hard Drive; 128 MbVRam Video Graphic Adaptor; 56 kbs Internal Fax/Modem; each with:

   a. Colour Monitor: 17" flat, non-interlaced screen, 1280x1024 dpi; low power, low radiation.

   b. Drives: one 32 x speed CD-Rom drive writeable.

   c. Ports: One parallel, two serial, keyboard and mouse.

   d. Keyboard: 101 key, English - Urdu.

   e. Mouse: "Microsoft".

   f. Operating System: "Windows XP".

   g. Anti-static dust covers.

2. Laser Printer: Similar to HEWLETT PACKARD "HP LaserJet 9000", with A3/A4 paper cassettes (Network enabled).

3. Internet: Multi-user subscription and connection to approved, local, Internet service provider.

4. Computer Workstation, comprising:

   a. Desking with wire management; to accommodate PC, monitor, keyboard and mouse.

   b. Operator's swivel chair.

D. **Fire Extinguishers**: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

E. Temporary Site Toilets: Prefabricated, self-contained, single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

F. **Drinking-Water Fixtures**: Containerized, tap-dispenser, bottled-drinking-water units, including paper cup supply.

1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 7.2 to 12.7 deg. C (45 to 55 deg. F).

G. **Electrical Outlets**: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

H. **Power Distribution System Circuits**: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

I. **Consultant's and Employer's Field Offices**: Provide new office furniture and equipment suitable for use intended. If acceptable to the Consultant, the Contractor may provide undamaged, previously used furniture and equipment in serviceable condition, to the extent approved by the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve the Works adequately and result in minimum interference with performance of the Works. Relocate and/or modify facilities as often as required by progress of the Works.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove facilities until permitted or directed to do so by the Consultant, or until replaced, to the satisfaction of the Consultant, by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. **General**: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company requirements and recommendations.

1. Arrange with utility company, the Consultant, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

2. Provide for adequate capacity and peak-demand or special load requirements at each stage of construction. Before temporary utility is available, provide trucked-in services if necessary.

3. Obtain any necessary easements to bring temporary utilities to Site.

4. Charges and Costs; Pay for all connection, service and user charges and costs arising in connection with the provision of temporary utilities.

B. **Sewers and Drainage**: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.

2. Connect temporary sewers to municipal system as directed by sewer department officials.

3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.

C. **Water Service**: Install water service and distribution piping in sizes and pressures adequate for construction.

1. Sterilize temporary water piping before use.

2. Provide storage tanks and/or rubber hoses as necessary to serve Site.

3. If at any time, temporary water service supply is interrupted or inadequate for requirements, provide back-up storage and truck-in water supplies as necessary.

4. If water pressure is inadequate, provide pumps to supply a minimum of 200-kPa static pressure at highest point. Equip pumps with surge and storage tanks and automatic controls to supply water uniformly at reasonable pressures.

D. Water Service: If use of the Employer's existing or permanent water service facilities is permitted, service, clean and maintain in a condition acceptable to the Consultant. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations, health codes and the Consultant's directions for

type, number, location, operation, and maintenance of facilities and fixtures. Provide separate toilet facilities for male and female personnel.

1. Generally: Install where facilities will best serve needs of the Works, including relocation whenever necessary.

   a. Service and maintain, and keep clean, sanitary and orderly for use.

   b. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.

2. Toilets: Install toilet facilities connected to local water and sewer lines. Provide lavatories, mirrors, and water closets. Provide only potable-water connections. Provide individual compartments for water closets. Provide suitable enclosure with nonabsorbent sanitary finish materials and adequate ventilation and lighting.

3. Toilets: If use of the Employer's existing or permanent toilet facilities is permitted, service, clean and maintain in a condition acceptable to the Consultant. At Substantial Completion, restore these facilities to condition existing before initial use.

4. Temporary Site Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.

5. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash-up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.

6. Drinking-Water Facilities: Install containerized, tap-dispenser, bottled-drinking-water units, including paper cup supply.

F. **Cooling**: Provide temporary cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.

1. Maintain a minimum temperature of 18 deg. C (64 deg. F) in permanently enclosed portions of building for normal construction activities, for finishing activities and areas where finished work has been installed.

G. **Ventilation and Humidity Control**: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or

elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

H. **Electric Power Service**: Provide weatherproof, grounded electric power service and distribution system of appropriate and sufficient size, capacity, and power characteristics required for use during construction, including necessary start-up, testing and commissioning of building operating systems and equipment. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.

1. Install electric power service underground, unless overhead service must be used.

2. Install power distribution wiring overhead and rise vertically where least exposed to damage.

3. If at any time, temporary electric power service supply is interrupted or inadequate for requirements, provide and operate back-up electric generators as necessary.

I. Electric Power Service: If use of the Employer's existing or permanent electric power service is permitted, maintain equipment in a condition acceptable to the Consultant. At Substantial Completion, restore equipment to condition existing before initial use.

J. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.

1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

K. **Lighting**: Provide temporary lighting with appropriate control and local switching to facilitate safe and proper execution of the Works. Provide adequate illumination to internal areas during finishing operations and for inspections.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

2. Install exterior site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.

3. Install lighting for Works identification sign.

L. **Telephone Service**: Provide and maintain adequate temporary telephone facilities and service for the duration of the Contract including Defects Liability Period, for all personnel accommodated in temporary field offices.

M. **Telephone Facilities for the Consultant**: Provide and install a PABX in the Consultant's field offices,:

1. Provide the following telephone facilities, line connections and services for the exclusive use of the Consultant and his staff:

a. 1 separate land line dedicated to PABX in the Consultant's field offices.

b. 1 separate land line dedicated to fax machine or modem in the Consultant's field offices.

2. **Charges and Costs**: Pay for all connection, service and user charges and costs arising in connection with the provision of telephone facilities and services for the Consultant.

3.3 SUPPORT FACILITIES INSTALLATION

A. **General**: Comply with the following:

1. Locate field offices, site laboratory, storage and fabrication sheds, workshops, sanitary facilities, and other temporary construction and support facilities for easy access.

2. Maintain support facilities until near Substantial Completion. Unless otherwise directed, remove before Substantial Completion, but retain adequate support facilities to accommodate personnel remaining on Site after Substantial Completion, including relocating if necessary and under conditions acceptable to the Employer / Consultant.

B. **Contractor's Site Offices**: Provide and maintain temporary offices and facilities of sufficient size, number and type to accommodate required office personnel, including sub-contractors, at the Site. Furnish and equip as necessary. Keep clean and orderly for use.

C. **Employer's and Consultant's Field Offices**: maintain and service all the temporary offices and facilities for the exclusive use of the Consultant/Employer's Representative, and their staff, sized, arranged, finished and equipped to the approval of the Consultant:

2. Staff Offices;

a. Regularly service and maintain office machines and equipment in good serviceable condition. Provide and continuously stock offices with all associated consumables, and supplies as and when required or

requested, including stationery and papers. The cost of which are to be borne by the Contractor.

3. Toilets;

   a. Service and maintain, and clean toilets on a daily basis. Provide and continuously stock with all associated consumable and supplies as and when required or requested, including soaps, toilet paper and paper towels. The cost of which are to be borne by the Contractor.

D. **Temporary Roads and Paved Areas**: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Submit proposals and obtain prior approval to locate temporary roads and paved areas coincidental with and in same location as permanent roads and paved areas. In such cases review any proposed modifications to permanent paving with the Consultant, and:

1. Comply with applicable requirements in appropriate Sections of the Specification for sub-grade, sub-base and base course construction of temporary paving.

2. Coordinate elevations and development of temporary roads and paved areas with subgrade grading, compaction, installation and stabilization of subbase, and installation of base and finish courses of permanent paving.

3. Install temporary roads and paved areas to minimize the need to rework the installations and to result in permanent roads and paved areas without damage or deterioration when occupied by the Employer.

4. Recondition and repair base after temporary use, including removing contaminated material, regrading, proof-rolling, compacting and testing.

5. Delay installation of the final course of permanent pavement until immediately before Substantial Completion. Coordinate with weather conditions to avoid unsatisfactory results.

6. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations, including delivery and storage of materials, equipment usage, administration and supervision.

E. **Traffic Controls**: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.

F. **Dewatering Facilities and Drains**: Comply with requirements in applicable Division 2 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections.

Where feasible, use same facilities. Maintain Site, excavations, and construction free of water.

1. Dispose of rainwater in a manner that will not result in flooding of Site or adjoining property nor endanger Permanent Works or temporary facilities.

2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.

G. **Works Identification and Temporary Signs**: Provide Works identification and other signs of appropriate sizes and types. Install signs to inform public generally and persons seeking entrance to Site. Do not permit installation of unauthorized signs.

1. Design, fabricate and erect two Works identification signs in approved locations. Support on posts or framing of paint finished, preservative-treated wood or galvanized steel.

2. Engage an experienced sign manufacturer to apply graphics for Works identification signs. Write sign in both English and Arabic, and include:

   a. Works name.

   b. Employer's name, style and logo.

   c. Consultant's name, style and logo

   d. Contractor's name, style and logo.

   e. Such other names, details and information as permitted and/or directed.

3. Provide other appropriate temporary signs to provide directional and safety information to construction personnel and visitors.

H. **Waste Disposal Facilities**: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.

I. **Janitorial Services**: Provide janitorial cleaning services on a daily basis for all temporary offices, toilets, wash facilities, and similar areas.

J. **Office boys**: Provide 1 office boys exclusively for Consultant's/Employer's services.

K. **Storage and Fabrication Sheds**: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on site.

L. **Construction Aids and Miscellaneous Facilities**: Provide all necessary aids and miscellaneous facilities incidental and ancillary to the safe and efficient execution of construction operations and the carrying-out of work in a proper workmanlike manner, including but not necessarily limited to:

1. Scaffolds, ladders, walkways, platforms and guardrails.

2. Protective screens, chutes, coverings and roofs.

3. Small tools; hand and power operated.

4. Lifts and hoists for materials and workmen.

5. Protective clothing, including helmets, goggles, ear protectors and steel-toed safety boots.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints and nuisance to persons or establishments near Site.

A. **Storm water Control**: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

B. **Tree and Plant Protection**: Unless otherwise indicated, install temporary fencing located outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.

C. **Pest Control**: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-

control service to perform extermination and control procedures at regular intervals so that the Site will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

D. **Site Enclosure Fence**: Before construction operations begin install an enclosure fence with lockable entrance gates. Locate where directed. Enclose entire Site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Provide approved open mesh or solid panel fencing with posts set in concrete bases.

2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations

3. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

E. **Security Enclosure and Lockup**: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

1. Secure Storage: Where materials and/or equipment are of high value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of such materials and/or equipment to minimize the opportunity for theft.

F. **Barricades, Warning Signs, and Lights**: Comply with standards, code requirements and directions of the Consultant for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.

G. **Covered Walkways**: Where necessary, erect structurally adequate, protective, covered walkways for passage of persons along adjacent public streets adjacent to Site. Coordinate with entrance gates, other facilities, and obstructions. Comply with Consultant's directions and with regulations of authorities having jurisdiction.

1. Construct covered walkways using scaffold or shoring framing.

2. Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.

3. Paint and maintain in a manner acceptable to the Consultant.

H. **Temporary Enclosures**: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, inclement weather, other construction operations, and similar activities. Provide temporary weather-tight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Vertical Openings: Close openings of 2.5 m² or less with plywood or similar materials.

3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.

4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.

I. **Temporary Partitions**: Where necessary, construct, erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration, and to separate areas from fumes and noise.

J. **Temporary Fire Protection**: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Strictly observe all requirements and recommendations pertaining to fire safety on construction sites

as contained in the latest edition of the Fire Instruction Manual produced by the Fire Service Department of the Department of Civil Aviation.

1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.

   a. Field Offices: Class A stored-pressure water-type extinguishers.

   b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.

   c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.

4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.

5. Permanent Fire Protection: At earliest feasible date in each area of Works, complete installation of permanent fire-alarm and fire-protection facilities, including connected services, and place into operation and use. Instruct key personnel on use of facilities.

6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

7. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

8. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. **Supervision**: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. **Maintenance**: Maintain facilities in good operating condition until removal. Protect from damage caused by extreme temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

2. Maintain markers for underground lines. Protect from damage during excavation operations.

C. **Temporary Facility Changeover**: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. **Termination and Removal**: At the Consultant's sole discretion, remove each temporary facility either when need for its service has ended, or when it has been replaced by authorized use of a permanent facility, or at Substantial Completion. Complete, or if necessary, restore permanent construction that may have been delayed because of interference with a temporary facility. Repair damaged work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Unless otherwise specified, materials, products, equipment and facilities that constitute temporary facilities are the property of the Contractor.

2. The Employer reserves right to take possession of Works identification signs.

3. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, damaged by construction operations, as required by authorities having jurisdiction.

4. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures."

3.6 SAFETY PROGRAM

A. In addition to the requirements of the provisions of the General Conditions of Contract and other Contract requirements, the Contractor shall submit for the Consultant's approval, within 15 days after the effective date of the notice to proceed for the Works, a proposed Safety Program covering the following items:

1. Health and Safety Plan:

a. The Health and Safety Plan shall contain but not be limited to the following:

1) Safety Policy and Strategy.

2) Statutory and Contractual Framework for Safety.

3) Management Safety Responsibilities.

4) Safety Training and awareness.

5) Safety Reviews.

6) Safety Method Statements.

7) Reporting and Investigation.

8) Contingency Arrangements.

9) Safety Inspections and Audits.

10) Accident Procedures.

11) Site cleanliness and removal of rubbish.

12) Labor messing facilities.

b. The Contractor shall take into account that the works under this Contract may be undertaken simultaneously with other Package Contracts. The Contractor is to coordinate safety procedures with the Consultant and Safety Representatives from other Package Contracts to implement and maintain a common safety strategy.

c. Site Cleaning and Housekeeping: Each Package Contractor shall be responsible for cleaning and housekeeping in their own work areas. The provision of waste chutes, garbage skips and disposal shall be provided by each package Contractor Package Contractor.

2. Health and Safety Representatives:

a. The Contractor shall include within the Health and Safety Plan the name of the company's qualified Safety Officer. He shall also submit the name and qualification of a Health and Safety representative on site responsible for the implementation of the Health and Safety Plan on site. The site safety representative shall remain on site during operational working hours and shall coordinate with the safety representatives of other package Contractors.

b. Appointment of the site Health and Safety representative will be subject to the Consultant's approval.

c. If in the opinion of the Consultant there is an infringement or breach in the approved Health and Safety Plan, the Consultant reserves the right to instruct the Contractor to undertake immediate corrective action

without any liability for any additional costs or time implication incurred by the Contractor in undertaking the corrective action.

B. Upon the Consultant's approval of the Safety Program the Contractor shall, for the full term of the Contract, operate the Safety Program, maintain accurate records of safety activities and accident, and submit safety and accident reports to the Consultant on the approved forms.

END OF DOCUMENT

SECTION 8 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Related Drawing and Detail.

1.2 PROPRIETARY NAMES

A. In accordance with the PAKISTAN statutory requirements, unless unavoidable, no proprietary products or manufacturers have been named within this Specification.

1.3 SUMMARY

A. This Section includes administrative and procedural requirements relating to products to be used in the Works, including the following:

1. Selection of products for the Works.
2. Quality assurance.
3. Product delivery, storage, and handling.
4. Product warranties.
5. Product substitutions.
6. Comparable products.

B. Related Sections include the following:

1. Division 1 Section "References Standards and Definitions" for applicable industry standards for products specified.
2. Division 1 Section "Execution Requirements" for general procedural requirements governing execution of the Work.
3. Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.
4. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.4 DEFINITIONS

A. **Products**: Items purchased for incorporating into the Works, whether purchased for the Works or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed the requirements of the Specification.

4. Local Products: Naturally occurring materials found in GCC countries that satisfy the required standards, products manufactured in the PAKISTAN from naturally occurring materials found in GCC countries that satisfy the required standards, or products manufactured in the PAKISTAN that satisfy the required standards.

5. Other Products: All other products required for the Works that satisfy the required standards and which are excluded from the category of "Local Products".

B. **Substitutions**: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by the Contractor after the date of issue of the Letter of Acceptance. The following are not Substitutions:

1. Revisions to Contract Documents required by the Consultant or Employer.

2. Options for products, materials, equipment and methods of construction, already specified in Contract Documents, including "or approved equal" and "but are not limited to" options.

3. Contractor's compliance with governing regulations or lawful orders issued by authorities having jurisdiction.

C. Manufacturer's Instructions and Manufacturer's Recommendations mean latest published or printed version of 'manufacturer's written instructions' and 'manufacturer's written recommendations.

D. **Manufacturer's Warranty**: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to the Employer.

E. **Special Warranty**: Written warranty required by or incorporated into the Contract Documents, whether to extend time limit provided by manufacturer's warranty, or to provide for joint and several liability, or to provide more rights for the Employer.

1.5 SUBMITTALS

A. **Product List**: Prepare and submit a list, in tabular form, identifying those products that the Contractor intends to propose for the Works and include the generic names of such products. Include manufacturer's and supplier's name and proprietary product name for each product.

1. Coordinate product list with Contractor's Construction Program, the Submittals Schedule, and the Subcontract List.

2. Initial Submittal: Within 14 days after Commencement Date, submit 3 copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

    a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

3. Completed List: Within 42 days after Commencement Date, submit 3 copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.

4. Consultant's Action: The Consultant will respond in writing to the Contractor within 28 days of receipt of completed product list. The Consultant's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. The Consultant's response, or lack of response, does not constitute a waiver of requirement that products comply with the Contract Documents.

B. **Substitution Requests**: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use a form acceptable to the Consultant.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

   a. Statement indicating why specified material or product could not be provided.

   b. Coordination information, including a list of changes or modifications needed to other parts of the Works and to construction performed by the Employer and separate contractors, which will be necessary to accommodate proposed substitution.

   c. Detailed comparison of significant qualities of proposed substitution with those of the product or work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

   d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

   e. Samples, where applicable or if requested.

   f. List of similar installations for completed projects with project names and addresses and names and addresses of architects/Consultants and owners.

   g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

   h. Detailed comparison of Contractor's Construction Program using proposed substitution with products specified for the Works, including effect, if any, on the overall Time for Completion. If specified product or method of construction cannot be provided within the Time for Completion, include letter from manufacturer, stating reason for non-availability and/or delays in delivery.

   i. Cost information, including a proposal of change, if any, in the Contract Sum.

   j. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.

3. **Consultant's Action**: If necessary, the Consultant will request additional information or documentation for evaluation within one week of receipt of a request for substitution. The Consultant will notify Contractor of acceptance or rejection of proposed substitution within 28 days of receipt of request, or within 14 days of receipt of additional information or documentation, whichever is later.

    a. Form of Acceptance: Variation Order.

    b. Use product specified if the Consultant cannot make a decision on use of a proposed substitution within time allocated.

C. **Comparable Product Requests**: Submit three copies of each request for consideration. Identify product or fabrication to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Request Form: Use a form acceptable to the Consultant.

2. Documentation: Show compliance with requirements for approval.

3. Consultant's Action: If necessary, the Consultant will request additional information or documentation for evaluation within one week of receipt of a request. The Consultant will notify the Contractor of acceptance or rejection of proposed comparable product within 28 days of receipt of request, or within 14 days of receipt of additional information or documentation, whichever is later.

    a. Form of Acceptance: Variation Order, without additional compensation.

    b. Use product specified if the Consultant cannot make a decision on use of a proposed comparable product within time allocated.

1.6 QUALITY ASSURANCE

A. **Alternative Equivalent Standards**: Product references to industry standards establish quantitative and qualitative attributes, characteristics and properties, required to be inherent in the specified product. Standard products not conforming to referenced standards, but otherwise exhibiting the same essential properties and conforming to another recognized equivalent industry standard may be used, subject to approval and compliance with other specified requirements.

1. Comply with provisions in "Comparable Products" Article to obtain approval for use of a product conforming to an alternative equivalent standard.

B. **Compatibility of Options**: If the Contractor is given the option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.

2. If a dispute arises between contractors over concurrently selectable but incompatible products, the Consultant will determine which products shall be used.

C. **Source Limitations**: To the fullest extent possible, provide products of the same type and kind from a single source.

1. If a specified product is available only from a source that cannot produce or supply sufficient quantities to execute and/or complete requirements in a timely manner, request the Consultant to determine the most essential qualities, attributes and characteristics required in the specified product, in order to select a comparable product possessing the same relevant, significant properties.

2. Comply with provisions in "Comparable Products" Article to obtain approval.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

5. Store products to allow for inspection and measurement of quantity or counting of units.

6. Store materials in a manner that will not endanger the structure of the Permanent Works.

7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

9. Protect stored products from damage.

1.8 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of any obligations under requirements of the Contract Documents.

B. Warranty Requirements:

1. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.

2. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

3. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Employer has benefited from use of the work through a portion of its anticipated useful service life.

4. Employer's Recourse: Expressed warranties made to the Employer are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Employer can enforce such other duties, obligations, rights, or remedies.

C. **Rejection of Warranties**: The Employer reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

D. Where the Contract Documents require a special warranty, or similar commitment on the Works or part of the Works, the Employer reserves the right to refuse to accept the Works, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

E. **Manufacturer's and Special Warranties**: Prepare a written document, ready for execution, that contains appropriate terms and conditions, and identifies commencement date and warranty period. Submit a draft and obtain the Consultant's written approval before final product selection.

1. Manufacturer's Standard Form: Modified to include requirements and information specific to the Works, and properly executed; or

2. Special Form: Individually prepared and specially drafted to include requirements and information specific to the Works, and properly executed.

3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

F. Submittal of Warranties: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 SELECTION OF PRODUCTS WHERE PROPRIETARY NAMES ARE NOT USED

A. All products shall be to a standard not less than the minimum requirements specified.

B. In addition to compliance with the Specification, the Contractor shall submit such further documentation and warranties as the Consultant may request to demonstrate compliance.

C. The products selected and submitted by the Contractor shall fulfill the following criteria:

1. In selecting and submitting products for approval, the Contractor shall only submit products where the stated performance criteria are fully adequate for the operation intended and the Contractor in making the submittal warrants the fitness of purpose of the products.

2. Product manufacturers shall be fully qualified to manufacture the respective products and they shall possess a proven track record of not less than 5 (five) years (preferably 10 years) manufacturing experience in their field. Those with the maximum experience shall be given preference in approval by the Consultant.

3. "Other Products" shall be either manufactured in, or be a naturally occurring material found in, any of the following geographical locations: Western Europe, North America, Australia or Japan. However, Manufacturers originating from the stated geographical locations who operate in a geographical location other than the stated ones are also acceptable provided that the Contractor can demonstrate that the parent manufacturing company still operates in one of the stated geographical locations.

4. Submittals for "Other Products" assembled in the PAKISTAN must include evidence that demonstrates that the assembly is approved by the original manufacturer.

5. Submittals shall only include products where manufacturers can certify 'forward compatibility' (as applicable) of current models of their products with future models.

6. Submittals shall only include products produced by manufacturers who have received ISO certification for a period of not less than 3 years (preferably 7 years) and preference shall be given by the Consultant to those possessing the longest periods of certification.

7. Submittals shall only include products produced by manufacturers who have had not less than 3 years commercial experience (preferably 7 years) and preference shall be given by the Consultant to those possessing the longest periods.

8. Submittals shall include evidence to demonstrate that the various components of the products are certified by the product manufacturer with respect to specific suitability, country of origin, quality and reliability.

9. Submittals shall include type test certificates (as applicable) issued by an Internationally reputable and accredited testing facility.

10. Submittals for "Other Products" shall include evidence to demonstrate that proposed products have been represented in the PAKISTAN for a period of not less than 3 years (as at date of Tender) and that the PAKISTAN representative maintains a fully equipped and capable technical support facility.

11. Submittals for "Other Products" shall include evidence to demonstrate that the proposed products are supplied through an authorized dealer in the PAKISTAN.

12. Product submittals (as applicable) shall include a re-submittal of the following information as originally submitted by the Contractor for all products included in his Tender lists for "Local Products" and "Other Products":

    a. Guarantee particulars of the Product.

    b. Original catalog of the proposed product manufacturer.

    c. Schedule of users (including names of contact persons) for the previous 5 years.

    d. Schedule of recommended minimum spares based on normal running/usage in the environment proposed projected over a ten year period together with current price lists (major equipment).

    e. Life cycle cost for the product covering the cost of the equipment, spare parts, maintenance and energy consumption in the environment proposed for the lifetime of the product.

    f. Manufacturers' website address.

2.2 PRODUCT OPTIONS

A. **General Product Requirements**: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. The Employer reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," the Consultant will make selection.

5. Where products are accompanied by the term "match sample," sample to be matched is the Consultant's.

6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

7. Or Approved Equal: Where products are specified by name and accompanied by such terms as "or other equal and approved", "or approved equal" "or equal", or “but are not limited to” comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

   a. The Consultant reserves the right to limit selection to named products specified.

   b. Unless otherwise agreed, contract unit rates and prices will be deemed to be based on the use of named products specified in the Contract Documents.

B. **Product Selection Procedures**: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named, unless otherwise indicated.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements, unless otherwise indicated.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements, unless otherwise indicated.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers’ names, provide a product by one of the manufacturers listed that complies with requirements, unless otherwise indicated.

5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers’ names, provide a product by one of the manufacturers listed or another manufacturer

that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of a product by another manufacturer.

7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches the Consultant's sample. The Consultant's decision will be final on whether a proposed product matches satisfactorily.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, the Consultant will select color, pattern, or texture from manufacturer's product line that does not include premium items.

    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, the Consultant will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.3 PRODUCT SUBSTITUTIONS

A. **Timing**: The Consultant will consider requests for substitution if received within 60 days after date of Letter of Acceptance. Requests received after that time may be considered or rejected at discretion of the Consultant.

B. **Conditions**: The Consultant will consider the Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, the Consultant will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers the Employer a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities the Employer must assume. The Employer's additional responsibilities may include compensation to the Consultant for redesign and evaluation services, increased cost of other construction by the Employer, and similar considerations.

2. Requested substitution does not require extensive revisions to the Contract Documents.

3. Requested substitution is consistent with the Contract Documents and will produce indicated results.

4. Substitution request is fully documented and properly submitted.

5. Requested substitution will not adversely affect the Contractor's Construction Program.

6. Requested substitution has received necessary approvals of authorities having jurisdiction.

7. Requested substitution is compatible with other portions of the Works.

8. Requested substitution has been coordinated with other portions of the Works.

9. Requested substitution provides specified warranty.

10. If requested substitution involves other contractors, requested substitution has been coordinated with the work of such other contractors, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.4 COMPARABLE PRODUCTS

A. Where products are specified by name or industry standard, submit the following, in addition to other required submittals, to obtain approval of an unnamed or alternative equivalent industry standard, product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Works.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty, if any.

4. List of similar installations for completed projects with project names and addresses and names and addresses of architects/Consultants and employers, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT

SECTION 9 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Works including, but not limited to, the following:

1. Construction layout.
2. Field Consultations and surveying.
3. General installation of products.
4. Coordination of the Employer-installed products.
5. Progress cleaning.
6. Starting and adjusting.
7. Protection of installed construction.
8. Correction of work.

B. Related Sections include the following:

1. Division 1 Section "Project Management and Coordination" for procedures for coordinating field Consultanting with other construction activities.
2. Division 1 Section "Submittal Procedures" for submitting surveys.
3. Division 1 Section "Closeout Procedures" for final cleaning.

1.3 SUBMITTALS

A. Method Statement: Submit method statement to be used for construction layout.

B. Landfill Receipts: If Contract Documents contain requirement for hazardous waste disposal, submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Existing Conditions**: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Works.

1. Before construction, verify the location and points of connection of utility services.

B. **Existing Utilities**: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Works.

C. **Acceptance of Conditions**: Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the work is required by other Sections, include the following:

   a. Description of the work.

   b. List of detrimental conditions, including substrates.

   c. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3.2 PREPARATION

A. **Existing Utility Information**: Furnish information to the Consultant that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate, where necessary, with authorities having jurisdiction.

1. Notify the Consultant and the Employer not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without the Consultant's written permission.

B. **Field Measurements**: Take field measurements as required to fit the construction properly. Recheck measurements before installing each product. Where portions of the Works are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Works.

C. **Space Requirements**: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. **Review of Contract Documents and Field Conditions**: Immediately on discovery of any discrepancy or the need for a clarification of the Contract Documents, submit a request for information or instruction to the Consultant. Include a detailed description of discrepancy or problem encountered, together with recommendations.

3.3 CONSTRUCTION LAYOUT

A. **Method Statement**: Before verifying layout information shown on Drawings, prepare a detailed method statement comprising a descriptive narrative and drawings, clearly describing and identifying means and methods to be used for construction layout including but not limited to:

1. Establishing benchmarks and control points to set lines and levels at each storey of construction and elsewhere as needed to locate each element of the Works.

2. Locating offsets for gridlines.

3. Locating and sizing penetrations in structures as needed to transfer lines and levels horizontally and vertically.

B. **Verification**: Before proceeding to set out the Works, verify layout information shown on Drawings, in relation to the Contractor's site survey and existing benchmarks. If discrepancies are discovered, notify the Consultant promptly.

C. **General**: Set out the Works using accepted surveying techniques and practices.

1. Establish benchmarks and control points to set lines and levels at each storey of construction and elsewhere as needed to locate each element of the Works.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Check the location, level and plumb, of every major element as work progresses.

5. Notify the Consultant when deviations from required lines and levels exceed allowable tolerances.

6. Close site surveys with an error of closure equal to or less than the standard indicated or otherwise as acceptable to the Consultant.

D. **Record Log**: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by the Consultant.

1. Advise the Consultant when deviations, exceeding indicated or recognized tolerances, are detected.

2. Record deviations that are accepted and not corrected on Record (As-Built) Drawings.

E. **Auxiliary Services**: Cooperate with the Consultant and provide, when requested, auxiliary services to enable and assist the Consultant to check the Contractor's site survey, layout and control work, including means of access to Site, use of instruments and tapes, and supply of survey crew.

3.4 FIELD CONSULTANTING

A. **Identification**: The Consultant will identify existing benchmarks and control points.

B. **Reference Points**: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Works. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of the Consultant. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to the Consultant before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. **Benchmarks**: Establish and maintain a minimum of two permanent benchmarks on Site, referenced to data established by survey control points. Comply with the Consultant's instructions for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Record (As-Built) Drawings.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Works.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. **Record Log**: Maintain a log of field Consultanting work. Include dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by the Consultant.

3.6 PROGRESS CLEANING

A. **General**: Clean Site and work areas daily, including common areas. Coordinate and contribute to progress cleaning for Site and work areas jointly-used with other separate contractors. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 27 deg C.

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. **Site**: Maintain Site free of waste materials and debris.

C. **Work Areas**: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Works.

E. **Concealed Spaces**: Remove debris from concealed spaces before enclosing the space.

F. **Exposed Surfaces**: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. **Cutting and Patching**: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

H. **Waste Disposal**: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

E. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

F. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

G. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 CORRECTION OF WORK

A. **Repair or remove and replace defective construction**. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their original condition, unless otherwise specified.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF DOCUMENT

SECTION 10 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Sections include the following:

1. Division 1 Section "Construction Progress Documentation" for submitting final construction photographs and negatives.
2. Division 1 Section "Product Requirements" for general requirement for warranties.
3. Division 1 Section "Execution Requirements" for progress cleaning of Site.
4. Division 1 Section "Record (As-Built) Documents" for preparing and submitting Record Drawings and Record Specifications.
5. Divisions 2 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.3 SUBSTANTIAL COMPLETION

A. **Preliminary Procedures**: Before requesting inspection for determining date of Substantial Completion for the whole or any Section or part of the Works, complete the following:

1. Prepare, in a tabular format acceptable to the Engineer, a list of items to be completed and corrected (punch list). Include the value for each item on the list, and reasons why the work is not complete.

2. Submit a written undertaking in a form acceptable to the Engineer, to complete and/or remedy all items contained in the punch list, to the satisfaction of the Engineer, within the Defects Liability Period as defined elsewhere in the Tender/Contract Documents.

3. Obtain and submit releases permitting the Employer unrestricted use of the Works and access to services and utilities. Include occupancy permits, operating certificates, and similar releases as applicable.

4. Prepare and submit Record (As-Built) Documents, and operation and maintenance manuals.

5. Submit final construction photographs and photographic negatives, and similar final record information.

6. Terminate and remove temporary facilities from Site.

7. Advise the Employer, with copy to the Engineer, of impending changeover in utilities.

8. Submit changeover information related to the Employer's occupancy, use, operation, and maintenance.

9. Complete final cleaning requirements, including touch-up painting.

10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. **Inspection**: Submit a written request for inspection for Substantial Completion. On receipt of request, the Engineer will either proceed with inspection or notify the Contractor of unfulfilled requirements. The Engineer will issue a Taking-Over Certificate after satisfactory inspection or will notify the Contractor of items, either on the Contractor's list or additional items identified by the Engineer, that must be completed or corrected before Certificate will be issued.

1. Re-inspection: Request re-inspection when work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. **Preliminary Procedures**: Before requesting inspection for determining Final Completion, complete the following:

1. Submit certified copy of the Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

2. Submit pest-control final inspection report.

B. **Inspection**: Submit a written request for inspection for Final Completion. On receipt of request, the Engineer will either proceed with inspection or notify the Contractor of unfulfilled requirements. The Engineer will issue a Defects Liability Certificate after satisfactory inspection or will notify the Contractor of work that must be completed or corrected before Certificate will be issued.

1. Re-inspection: Request re-inspection when work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. **Preparation**: Submit three copies of list. Include name and identification of each building space and site area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by the Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:

   a. Works name.

   b. Date.

   c. Name of the Engineer.

   d. Name of the Contractor.

   e. Page number.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. **General**: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and local environmental and antipollution regulations.

B. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Employer's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Site and dispose of lawfully.

END OF DOCUMENT

SECTION 11 - RECORD (AS-BUILT) DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and other Related Drawing and Detail.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Record (As-Built) Documents, including the following:

1. Record Drawings.

2. Record Specifications.

3. Miscellaneous Records.

B. Related Sections include the following:

1. Division 1 Section "Summary of Multiple Contracts" for coordinating Project Record Documents covering the Work of multiple contracts.

2. Division 1 Section "Closeout Procedures" for general closeout procedures.

3. Divisions 2 Sections for specific requirements for Record (As-Built) Documents in those Sections.

4. Divisions 2 Sections for specific requirements for Miscellaneous Record keeping and submittal in those Sections.

1.3 SUBMITTALS

A. **Record Drawings**: Submit copies of Record Drawings as follows:

1. Initial Submittal: Submit two sets of plots from Record CAD Drawing files and the original marked-up Record Prints. The Consultant will initial and date one set of plots and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. The Consultant will return one set of plots and Record Prints together with review comments, for completing, printing, binding, and final submittal.

2. Final Submittal: After incorporating the Consultant's initial submittal review comments, submit:

a. Original marked-up Record Prints set.

b. Sets of (As-Built) Drawings as follows:

1) One (1) Set electronic format: (in CD-ROM)

2) One (1) set of Mylar reproducible polyester film (Mylar)

3) Two (2) bound sets of prints (A2 Size)

4) One (1) set of loose copy (blue print/black line print). Size should be the same as the original Mylar/Polyester films

5) One (1) set of any other document/report about the project, Test results and any other information/documents..

B. **Record Specifications**: Submit two (2) copies of Record Specifications, including addenda and contract modifications.

C. Miscellaneous Records: Submit two (2) sets of original miscellaneous records.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. **Record Prints**: During construction period, print and maintain one set of blue- or black-line white prints of all Contract Drawings, approved Shop Drawings and newly prepared Drawings, for Record Print purposes.

1. Preparation: Mark Record Prints to indicate all changes and field adjustments and to show the actual installation where installation varies from that shown originally.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Accurately record information in an understandable drawing technique.

c. Record data as soon as possible after obtaining it. Record and check the mark-up before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.

b. Revisions to details shown on Drawings.

c. Locations and depths of underground utilities.

d. Revisions to routing of piping and conduits.

e. Revisions to electrical circuitry.

f. Changes made by Variation or Site Instruction directives.

g. Changes made following the Consultant's written orders and the Consultant's acceptance of substitutions or alternatives, etc.

h. Details not on the original Contract Drawings.

i. Field records for variable and concealed conditions.

j. All coordinates shown on the drawings should be in DLTM.

3. Mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

4. Mark record prints with erasable, red-coloured pencil. Use other colours to distinguish between changes for different categories of work at the same location.

5. Mark important additional information that is either shown only schematically or omitted from original Drawings.

6. Note Variation numbers, Site Instruction numbers, and similar identification, where applicable.

B. **Newly Prepared Record Drawings**: Prepare new Drawings where the Consultant determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Variation is issued or as a result of the Consultant accepting an alternate, substitution, or other modification.

2. Consult with the Consultant for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

C. **Progress Review**: Unless otherwise indicated or directed, submit a copy of marked-up Record Prints and newly prepared Record Drawings at monthly intervals, for progress review and acceptance by the Consultant.

1. Limit submittals to drawings marked-up, prepared or further amended since previous submittal. List drawings contained in each submittal on transmittal form.

D. **Record CAD Drawings**: Before requesting inspection for determining date of Substantial Completion, review marked-up final Record Prints with the Consultant. When authorized, prepare a full set of CAD Drawings of all Contract Drawings, Shop Drawings and newly prepared Drawings, whether or not changes or additional information are recorded:

1. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.

2. Refer instances of uncertainty to the Consultant for resolution.

3. Identify and date each Record Drawing; include the designation "RECORD (AS-BUILT) DRAWING" in a prominent location.

E. **Record CAD Drawing Plots**: Produce a full set of Record Drawing Plots from completed Record CAD Drawing files.

F. Final Submittal Format:

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with thick cover sheets. Include identification and list contents on cover sheets.

2. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Record Prints. Produce "List of Drawings" sheet. Name each file with the sheet identification number. Include identification in each CAD file. All as follows:

a. All As-Built drawings and GIS files to be submitted in DLTM coordinate system, which is UAE Standard coordinate system.

b. The master map unit for As-Built drawings and GIS files should be in meter (m) only. (For Microstation drawings, sub unit should be 1000 (mm) and positional unit should be 80).

c. All As-Built CAD drawings and GIS files to be submitted in digital formats on CD’s media.

d. As-Built CAD and GIS formats are both required for any As-Built design / entity submission.

e. All As-Built GIS maps to be submitted in standard shape files.

f. All As-Built CAD drawings should be submitted in original Microstation format, (not converted), unless special permission is obtained from DCA for other format.

g. In the event of such special permission being granted, for AutoCAD drawings, pen width details for plotting should also be provided in each drawing. (Outside the drawing area).

h. In Microstation files for 2D drawings always use 2D seed files.

i. All reference files (if used) should be copied in a directory called 'reference'.

j. If any of the files/drawings are using fonts other than the normal fonts provided by the software, that fonts also should be copied in a separate directory called 'fonts'.

k. Drawing should be neat and perfect. None of the items should be outside the drawing sheet area.

l. Drawings of different disciplines (i.e. Architectural, Structural, Electrical, Mechanical etc.) should be kept in separate directories with suitable names.

m. One file shall contain only one drawing.

n. Drawing should be drawn/organized in suitable/proper layers/levels. Same kind of items should always be in the same layer/level.

o. Drawing should be copied into CD' in such a way that, when one drawing from the CD is opened, it must be complete and all reference files, fonts and libraries (if used) should attach automatically.

p. The index of drawings should also be provided in the original format of the drawing (DGN or DWG) and it must be kept in a directory called "general".

q. Total number of As-Built drawings in the index and in the CD should be the same.

r. Change notice drawings should submit along with all other drawings of that TD in a new CD.

3. Polyester Copy (Mylars): Organize into unbound sets matching Record Prints. Place in durable tube-type drawing containers with end caps. Mark end cap of each container with identification. If container does not include a

complete set of Drawings, attach label and identify Drawings included. All as follows:

a. All the drawings must be either A0 or A1 size. (Standard).

b. Maximum size of the sheet should not exceed 1200 x 880 mm.

c. All drawings must be in good quality polyester films and not in tracing paper.

4. Copy Prints: Organize into bound sets matching Record CAD Drawing Plots. The Consultant will deliver the Employer copy sets. All as follows:

a. They must be in standard in A2 size.

b. They must be properly bound using thick covering sheets.

c. Laminated labelling must be as in the following format:

<PROJECT TITLE>

d. The scale of the drawings in the bound book should match with the scale shown in the title block of the drawing of bound book.

5. General (for Soft copy & Hard copy)

a. Each document should be verified thoroughly by the consultant/contractor before submission.

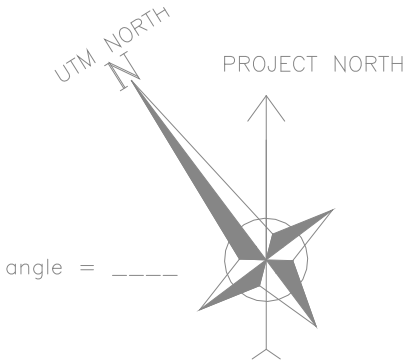
b. "As-Built" stamp/seal with date and signature of the verified person should be provided in each drawing.

c. "As-Built" stamp/seal (item 5. b above) should be exactly like below:

d. Drawing should be in proper scale and Contract number, its description & scale of the drawing should also be mentioned in the title block along with other details.

e. Key plan & north symbol should be provided in the upper right corner of the drawings (wherever it is applicable).

f. North symbol (item 5. e above) should be like as below sample:



g. Provide hard copy of list (index) of drawings as in the following format:

Discipline (Architectural, Structural, Mechanical, etc.)					
Sl. No.	Sheet no.	Drg. No.	Rev no.	Drg. File name	Description

h. All the drawings must be numbered serially (sheet number), starting from 001 (drawing index as sheet no. 001) and it must be showed in the drawing index. (Total number of drawings in one Contract should be same as the sheet number of the last drawing).

i. One file should contain only one drawing. (This point is also incorporated under item 2.1. F.2 above).

j. All As-Built drawings and GIS files to be submitted in DLTM coordinate system which is UAE Standard coordinate system.

k. All As-Built CAD drawings and GIS files to be submitted in digital formats on CD's media.

l. As-Built CAD and GIS formats are both required for any As-Built design / entity submission.

m. All As-Built GIS maps to be submitted in standard shape files.

n. All naming, numbering and related attribute information for As-Built to be matched with DCA standards.

2.2 RECORD SPECIFICATIONS

A. **Record Specifications**: During construction period, print and maintain two copies of the Specifications, including addenda and contract modifications issued, for Record Specification purposes.

B. **Preparation**: Mark Record Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Record the name of the manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.

4. Note related Variation numbers and Record Drawings where applicable.

2.3 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference. Miscellaneous records include, but are not limited to, the following:

1. Field records on excavations and fillings.

2. Surveys showing locations and elevations of underground lines.

3. Special and authorized measurements.

4. Tests and inspections.

5. Inspections and certifications by governing authorities.

6. Final inspection and correction procedures.

7. Any other information / documents which are not included on As-Built Drawings and Operation and Maintenance Manuals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. **Recording**: Mark up Record Documents as the Work is progressively accomplished and completed relative to each Record Document. Record changes and modifications as they occur; do not wait until the end of Project.

B. **Maintenance of Record Documents**: Store Record Documents in field office, apart from the Contract Documents used for construction. Do not use Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Make Record Documents available for the Consultant's inspection and reference during normal working hours.

END OF DOCUMENT

SECTION 12 - DEMOLITION & REMOVAL

PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

1.1.1 Read and conform to:

a. Comply with Division 1 requirements and documents referred to herein.

1.2 SUMMARY

1.2.1 Work Included: Provide demolition and salvage including but not limited to following:

a. selective demolition to accommodate alterations.

b. new openings.

1.2 DEFINITIONS

a. Hand Demolition: Systematic demolition of structures by workers using hand-held tools.

b. Mechanical Demolition: Systematic demolition of structures using powered equipment.

c. Systematic Demolition: Methodical dismantling of structure piece by piece, usually carried out in reverse order of construction.

1.3 SUBMITTALS

a. Plan of Action: Submit "Plan of Action" immediately after award of Contract for review by Consultant.

b. Where required by authorities having jurisdiction, submit drawings, diagrams or details showing sequence of dismantling work and shoring of structures during demolition.

1.4 QUALITY ASSURANCE

a. Regulatory Requirements:

i. Conform to Health and Safety laws in Pakistan for Construction Projects

ii. Conform to Fire Department Regulations.

iii. Post danger signs conspicuously around property. If requested, provide a watchman for patrolling site when work is not in progress to prevent public entering danger zone and to maintain barricades.

iv. Provide fire extinguishers acceptable to fire prevention authorities in locations and of type suitable to enable personnel to with fire occurring during progress of work.

1.5 Qualifications:

a. Employ for this work, a demolition company having 5 years experience in this type of work satisfactory to Consultant. If requested, submit proof of experience. Employ a full time professional structural Consultant registered in PAKISTAN to prepare plan of action, Consultant temporary shoring, bracing. Inspect this work during demolition, fabrication and erection of shoring and bracing. Provide site administration and inspection of work of this Section.

b. Pre-Demolition Meeting:

c. Prior to start of work, arrange for site meeting of all parties associated with work of this Section. Presided over by Consultant, meeting shall include Contractor, demolition Subcontractor, testing company's representative and structural Consultant.

d. Review specification for work included under this Section and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, inspection of construction to be demolished, methods to be used, sequence and quality control, Project staffing, restrictions due to environmental protection requirements and other matters affecting demolition, to permit compliance with intent of this Section. Review structural load limitations of existing structures. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays. Review and finalize protection requirements.

1.6 PROJECT CONDITIONS

a. Maintain Access Road to Buildings: Do not disturb existing temporary fencing. Maintain construction traffic reasonable distance away from fence line. Repair damage which is result of Work of this Contract.

b. Do not close or obstruct roads, streets, sidewalks, passageways without permits. Do not place or store materials in streets or passageways. Conduct operations with minimum interference with roads, streets, driveways and passageways.

1.7 SCHEDULING

a. Phase selective demolition as indicated on Drawings to accommodate new construction.

b. Demolition and removal of electrical equipment services designated for removal on Drawings and as required by Work. Disconnecting and capping prior to authorizing removal

2. PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 PREPARATION

a. Preliminary Survey:

i. Before commencing demolition operations, examine site and when requested, provide Consulting survey to determine type of construction, condition of structure and site conditions. Assess strength and stability of damaged or deteriorated structures.

ii. Assess potential effect of removal of any part or parts on remainder of structure before such part(s) are removed.

iii. Assess effects of demolition on adjacent properties and consider need for underpinning, shoring and/or bracing.

iv. Investigate for following conditions:

a. load-bearing walls and floors.

b. structure suspended from another.

c. cantilevered construction.

d. presence of prestressed or post-tensioned elements.

e. effects of soils, water, lateral pressures on retaining or foundations walls.

f. presence of hazardous materials.

v. Contact municipal authorities or utility companies for assistance in locating and marking services passing under, through, overhead or adjacent to

structure to be demolished. Such services without limitations include:

a. electrical power lines.

b. gas mains.

c. oil pipelines.

d. communication cables.

e. water mains.

f. drainage piping (storm and sanitary).

g. steam distribution.

1. After determining demolition methods, determine area of possible vibration. Carefully inspect beyond those adjacent areas. List potential damage areas and photograph each for record purposes before starting work.

3.2 Protection:

a. Do not interfere with use and activities of occupants where applicable and adjacent buildings. Maintain free and safe passage to and from buildings. Maintain integrity of existing fire exits.

b. Protect existing adjacent work against damages which might occur from falling debris or other causes due to work of this Section.

c. Provide, erect and maintain required hoarding, sidewalk sheds if applicable, catch platforms, lights and other protection around site before commencing work. Maintain such areas free of snow, ice, mud, water and debris. Lighting levels shall be equal to that prior to erection.

d. Provide flagmen where necessary or appropriate to provide effective and safe access to site to vehicular traffic and protection to pedestrian traffic.

e. Ensure scaffolds, ladders, equipment and other such equipments are not accessible to public. Protect with adequate fencing or remove and dismantle at end of each Day or when no longer required.

f. Do not interfere with use and activities of adjacent buildings. Maintain free and safe passage to and from buildings.

g. Where necessary to seal fire exits of adjoining or adjacent buildings, provide other exits in compliance with applicable fire safety and building regulations.

h. Where demolition operations prevent normal access to adjacent properties, provide and maintain suitable alternative access.

i. If at any time safety of adjacent buildings appear to be endangered, cease operations and notify Consultant; take precautions to support buildings; do not resume operations until permission is granted by Consultant.

j. If Consultant considers additional bracing and shoring necessary to safeguard and prevent such movement or settlement, install bracing or shoring upon Consultant's orders. Should Contractor fail to comply promptly with such request, such bracing or shoring may be placed by Consultant at Contractor's expense.

k. Take precautions to guard against movement, settlement or collapse of adjacent services, sidewalks, driveways, or trees. Be liable for such movement, settlement or collapse caused by failure to take necessary precautions. Repair promptly such damage when ordered.

l. Erect and maintain partitions as required to prevent spread of dust, fumes and smoke to other parts of building. Maintain fire exits from site. On completion, remove partitions and Make Good surfaces to match adjacent surfaces of building.

3.3 Restrictions:

Restrict demolition activities between hours of 7:30 a.m. and 5:00 p.m., Monday through Friday. Special permission for after hour may be obtained from Owner / Authorities.

3.4 Existing Services:

a. Notify Local City Government to cut-off, remove and cap Municipal services. Verify services are cut off and properly capped before commencing associated or effected demolition. Cap and cover catch basins outside the building during the work of this Section. Do not allow demolition debris into the drains.

b. Provide and maintain temporary services required during demolition to satisfaction of authorities having jurisdiction, fire departments and utility companies.

c. Verify prior to commencement work of this Section that disconnection and capping of mechanical services have been carried out under Division 15 in accordance with requirements of local authority having jurisdiction. Make sure Natural gas supply lines are being removed by Gas Company or by qualified tradesman in accordance with Gas Company instructions. Removal and disposal of other existing underground services and mechanical equipment shall be by Division 15.

d. Before commencing demolition, contact Electrical Department of local authority and tour site with them. Disconnect and seal electrical power lines and communications cables entering buildings to be demolished. Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.

e. In event of unexpected discovery of buried fuel or other tanks, do no further work and immediately report discovery, orally and in writing to Consultant. Consultant will authorize remedial work, if any, in writing. Do such remedial work, as addition to Contract.

f. Remove electrical equipment scheduled for removal on Drawings and as required by Work.

g. Remove sewer and water lines to extent indicated on Drawing and cap to prevent leakage.

3.5 PERFORMANCE

a. Demolition action plans may indicate only general scope of work to be demolished and removed. It is Contractor's sole responsibility to determine exact extent of demolition required. Contractor may not rely solely on Drawings to limit scope of selective demolition work required. Review site conditions and assess exact scope of demolition and removal.

b. Examine and review existing conditions prior to starting demolition. Initially perform demolition only in selected and designated test areas prior to proceeding full scale demolition work. Obtain approval on technique of demolition in test areas from Consultant. Only after approval, proceed in other areas.

c. Materials and debris shall not be stacked in building to extent that overloading of any part of structure will occur.

d. At end of each Day's work leave work in safe condition ensuring no parts of structure are in danger of collapsing.

e. Demolition:

f. Ensure demolition work is supervised by licensed structural Consultant at all times.

g. Do not create falling materials hazard.

h. Remove all mechanical and electrical items indicated to be removed.

i. Keep work wetted down to minimize dust.

j. Minimize noise. Avoid use of noisy machinery outside working hss ours.

3.6 Building Services:

a. Arrange with Owner to disconnect existing building services. Cut-off and cap existing building services under Owner's supervision. Provide caps to abandoned services.

b. Prevent demolition debris from entering building drains.

c. All items indicated on Drawings or designated on site by Consultant, materials forming permanent part of structure being demolished shall become property of this Section. Remove from site.

3.7 DISPOSAL OF WASTE MATERIALS

a. Clear away dirt, rubbish and loose litter resulting from work of this Section, minimum daily. Keep dust to a minimum. When necessary and practical demolition works shall be sprayed periodically with water to reduce dust. Wet down debris from time to time to control dust. Maintain roadways, lanes and street sidewalks in the vicinity of the premises safe and clear.

b. Selling or burning of materials on site is not permitted.

c. Conform to requirements of municipality's Works Department regarding disposal of waste materials.

d. Materials prohibited from municipality waste management facilities shall be removed from site and dispose of at recycling companies specializing in recyclable materials.

e. Excavated material including contaminated excavated material shall be removed from site and dispose of to requirements of authorities having jurisdiction without any additional cost to Owner.

f. Any additional materials prohibited from waste management facilities shall be removed from site and dispose of to requirements of authorities having jurisdiction without any additional cost to Owner.

END OF DOCUMENT

SECTION 13 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including Conditions of Contract apply to this Section.

1.2 SUMMARY

A. This Section includes construction dewatering.

B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities"
2. Division 2 Section "Site Clearing."
4. Division 2 Section "Earthwork" for excavating, backfilling, and site grading.

1.3 PERFORMANCE REQUIREMENTS

A. **Dewatering Performance**: Design, provide, test, operate, monitor, and maintain a dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable sub grades.

1. Work includes removing dewatering system when no longer needed.
2. Maintain dewatering operations to ensure erosion is controlled, stability of excavations and constructed slopes is maintained, and flooding of excavation and damage to structures are prevented.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Undertake all necessary temporary works to accomplish dewatering without damaging existing buildings, structures, utilities and site improvements adjacent to excavation.

1.4 SUBMITTALS

A. **Shop Drawings**: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water.

1. Include layouts of pedometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written report outlining control procedures to be adopted if dewatering problems arise.
3. Include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

B. **Qualification Data**: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects

with project names and addresses, names and addresses of architects/engineers and owners, and other information specified.

C. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

D. **Field Test Reports**: Before starting excavation, submit test results and computations demonstrating that dewatering system is capable of meeting performance requirements.

E. **Field Records**: Survey logs and Observation well reports.

1.5 QUALITY ASSURANCE

A. **Installer Qualifications**: Engage an experienced installer to assume engineering responsibility and perform dewatering who has specialized in installing dewatering systems similar to those required for this Project and with a record of successful in-service performance.

B. **Professional Engineer Qualifications**: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services for designing dewatering systems that are similar to those indicated for this Project in material, design, and extent.

1. Engineering Responsibility: Engage a qualified professional engineer to prepare or supervise the preparation of data for the dewatering system including drawings, testing program, test result interpretation, and comprehensive engineering analysis that shows the system's compliance with specified requirements.

C. **Regulatory Requirements**: Comply with water disposal requirements of authorities having jurisdiction.

1.6 PROJECT CONDITIONS

A. **Existing Utilities**: Do not interrupt or interfere with utilities serving facilities on the Project site or on adjoining property unless permitted in writing by the Engineer and then only after arranging to provide temporary utility services according to requirements indicated or directed.

B. **Project Site Information**: A geotechnical assessment has been prepared for this Project and has been made available for information only. The Contractor is entirely responsible for his own assessment, interpretation, use and conclusions drawn from the information, data, tests, analyses and opinions contained in the assessment.

1. Make additional test borings and conduct other exploratory operations as deemed necessary, at own cost and expense.

C. Survey adjacent structures and site improvements, employing a qualified professional engineer or surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. Weekly during dewatering, and at completion, resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify the Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements and other facilities, on or adjacent to the site, from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

B. Install dewatering system to ensure minimum interference with adjoining roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Engineer and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by the Engineer or authorities having jurisdiction.

3.2 DEWATERING

A. Provide, design, install, and operate a dewatering system that will minimize conditions, or softening of foundation strata; and maintain stability of the sides and bottom of excavation, all resulting in every phase of excavation, construction, and backfilling operations being performed in the dry.

B. Reduce hydrostatic head in the water-bearing strata to below structure foundations, drains, sewers and other excavations to extent that ground water levels in construction areas are below the maximum excavation depth by a minimum of 1 m.

C. Prior to excavation below groundwater level, place dewatering system into operation to lower and maintain the specified water levels for a 24-hour period and then operate it continuously 24 hours a day, 7 days a week until drains, sewers and structures have been constructed, including placement of fill materials, and until written authorization to cease dewatering is received from the Engineer.

D. Control of all surface and subsurface water resulting from operations. Dispose of water removed from excavations in a manner to avoid endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner to avoid inconvenience to others in a manner approved by the Engineer.

E. Provide standby equipment on the Project site, installed and available, for immediate operation if required to maintain dewatering on a continuous basis in the event that any part of the system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform such work as may be required to restore damaged structures and foundation soils at no additional expense.

F. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

G. Dispose of water removed from excavations in a manner to avoid endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner to avoid inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices acceptable to the Engineer and as required by authorities having jurisdiction.

H. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or other acceptable material, or cut off and cap wells a minimum of 900 mm below overlying construction.

I. Damages: Promptly repair and restore to original condition, any damages to adjacent structures, utilities, sidewalks, pavements and other facilities on or adjacent to the site, caused by dewatering operations, to the satisfaction of the Engineer.

3.3 OBSERVATION WELLS

A. Provide, take measurements, and maintain as a minimum at least four observation wells or piezometers in locations indicated or directed, together with any additional observation wells as may be required by the Engineer or authorities having jurisdiction.

B. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

C. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. Suspend construction activities in areas where observation wells are not functioning properly until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

1. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

3.4 INSPECTION

A. Inspect the dewatering system at least once each day during periods when the workforce is not on the Project site.

END OF DOCUMENT

SECTION 14 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including Conditions of Contract apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing and grading sub-grades for slabs-on-grade and pavements.
2. Preparing sub-grades for roadways and vehicular pavements.
3. Excavating and backfilling for buildings and structures.
4. Excavating and backfilling for roadways and vehicular pavements.
5. Drainage and moisture-control fill course for slabs-on-grade.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches and pits within building lines.
8. Excavating and backfilling trenches and pits for buried mechanical and electrical utilities and appurtenances.
9. Excavation support and protection not otherwise provided for in other Sections of the Specification.

B. Related Sections include the following:

1. Division 2 Section "Dewatering" for lowering and disposing of ground water during construction.
2. Division 2 Section "Aggregate Sub-base" for sub-base to roadways and vehicular pavements.
3. Division 2 Section "Aggregate Base Course" for base course to roadways and vehicular pavements.
4. Division 2 Section “Bituminous Concrete Pavement" for areas to be paved with asphalt.

1.3 DEFINITIONS

A. **Excavation**: consists of the removal of material encountered to sub-grade elevations and the reuse or disposal of materials removed.

B. **Backfill**: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

C. **Borrow**: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

D. **Drainage Blanket**: Course of washed granular material placed to cut off upward capillary flow of pore water.

E. **Unauthorized Excavation**: Unauthorized excavation consists of removing materials beyond indicated sub grade elevations or dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, will be at the Contractor's expense.

F. **Structures**: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.

G. **Utilities**: Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

H. **Bedding Course**: Layer placed over the excavated sub-grade in a trench before laying pipe.

I. **Capillary Water Barrier**: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

J. **Fill**: Soil materials used to raise existing grades generally.

K. **Sub-grade**: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill or sub grade layer, immediately below sub base, drainage fill, slab-on-grade, or topsoil materials.

1.4 SUBMITTALS

A. **Pre-construction Records**: Before an excavation is started:

1. Ground levels shall be agreed at suitable intervals with the Engineer.
2. Surface materials and conditions shall be recorded in presence of the Engineer and where appropriate, the Employer or occupiers of the land.
3. The Contractor shall take photographs to illustrate existing damage or conditions, which may prove contentious at the time of reinstatement.
4. This information shall be neatly presented and submitted to the Engineer.

B. Any significant details of any existing natural or piped subsoil drainage or other underground features shall be identified to the Engineer as work proceeds.

C. For excavations for pipelines or lengthy conduit installations, trial excavations shall be carried out along the route of pipeline/underground conduit for location of all existing services and findings shall be presented on drawings with location, type and levels. All services shall be included in final drawings. The excavations shall not be backfilled without approval.

D. **Temporary Support System**: Design of temporary support system, where required.

E. **Product Data**: For the following:

1. Each type of plastic warning tape.
2. Drainage fabric.
3. Separation fabric.

F. **Samples**: For the following:

1. 50 kg samples sealed in airtight containers, of each proposed soil material from on-site or borrow sources.
2. 300 mm x 300 mm sample of drainage fabric.
3. 300 mm x 300 mm sample of separation fabric.

G. **Material Test Reports**: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for backfill, fill, embankment and sub grade layer.
2. Laboratory compaction curve according to ASTM D 1557 (Modified Proctor) for each on-site or borrow soil material proposed for backfill, fill, embankment and sub grade layer.

1.5 QUALITY ASSURANCE

A. **Geotechnical Testing Agency Qualifications**: An independent testing agency acceptable to the Engineer and qualified according to ASTM E 329 to conduct soil materials testing, as documented according to ASTM D 3740 and ASTM E 548.

B. **Pre-excavation Conference**: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Coordination."

1.6 PROJECT CONDITIONS

A. **Existing Utilities**: Survey to determine locations, sizes, and types of such utilities within construction areas in advance of disturbing them. Provide proper safeguard, support and protection from construction activities. Do not interrupt existing utilities serving facilities occupied by the Employer or others except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.

1. Provide a minimum 48-hours' notice to the Engineer and receive written notice to proceed before interrupting any utility.

B. **Traffic Control**: Maintain access for vehicular and pedestrian traffic as required for other construction activities in the area and as discussed/directed by the Engineer.

C. Demolish and completely remove from site existing underground piping, conduit, manholes, and other utilities within the limits of excavations, which are indicated to be abandoned, and plug open ends with concrete.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. **General**: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. **Satisfactory Soils**: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 75 mm in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. **Unsatisfactory Soils**: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. **Backfill and Fill**: Satisfactory soil materials.

E. **Sub grade Layer**: Satisfactory roadway soil materials, but conforming with the following requirements:

1. Size: 100 percent passing a 75 mm sieve and not more than 18 percent passing a 0.075 mm sieve.
2. Organic Matter: Not more than 5 percent; AASHTO T 267.
3. Maximum Dry Density: Not less than 1.7; AASHTO T 180.
4. CBR: Not less than 15 percent; AASHTO T 193.
5. Maximum Plasticity Index: 12 percent.
6. The top 150 mm sub grade material should not contain more than 0.2% total sulphate content and 0.05% total chloride content.

F. **Controlled Fill**: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; AASHTO M 57; with at least 90 percent passing a 38 mm sieve and not more than 12 percent passing a 0.075 mm sieve.

G. **Bedding**: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 25 mm sieve and not more than 8 percent passing a 0.075 mm sieve.

H. **Drainage Fill**: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 38 mm sieve and 0 to 5 percent passing a 2.36 mm sieve.

I. **Filter Material**: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 25 mm sieve and 0 to 5 percent passing a 4.75 mm sieve.

2.2 ACCESSORIES

A. **Warning Tape**: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities and as per DEWA standard, 150 mm wide and 0.1 mm thick, continuously inscribed with a description of the utility; colored as follows:

B. **Detectable Warning Tape**: Acid and alkali resistant polyethylene film warning tape manufactured for marking and identifying underground utilities and as per local authority guidelines, minimum 150 mm wide and 0.1 mm thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 750 mm deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

C. **Drainage Geocomposite**: composed of a drainage geonet core with nonwoven geotextile bonded to both sides of the geonet core. The geotextile shall only be heat bonded to the geonet core; no other means of bonding shall be used. The polymer used to manufacture the geonet core shall be high density polyethylene. Manufacturer shall certify that the geonet is manufactured from first quality virgin polymer and no regrind material is used in the geonet manufacturing process. The nonwoven geotextile shall be made from needle punched or heat-bonded polypropylene or polyester staple or continuous fiber. Alternative to these materials and manufacturing processes may be approved by the Engineer. Conformance to the following properties shall be according to ASTM D 4759 and referenced standard test methods:

Geonet

Thickness (Min): 0.635 cm; ASTM D 5199

Tensile Strength (Min): 5.8 kN/m; ASTM D 4595

Density (Min): 0.94 g/cm^3, ASTM D 1505

Melt Flow Index (Max): D 1238 g/10 min 1.0; ASTM D 1238

Carbon Black Content (range): 2 -3 %; ASTM D 1603

Geotextile

1. Grab Tensile Strength (Min): 712 N; ASTM D 4632.
2. Tear Strength (Min): 266 N; ASTM D 4533.
3. Puncture Resistance (Min): 266 N; ASTM D 4833.
4. Apparent Opening Size (Max): 0.21 mm; ASTM D 4751.

Geocomposite

Ply Adhesion (Min): 90 g/cm; ASTM D7005

Transmissivity (Min): 1.0E-03 m^2/sec; ASTM D4716. Transmissivity is measured after 100 hours seating period with boundary conditions: Ottawa Sand/ GDL/ Geomembrane/ Steel Plate at a hydraulic gradient of 0.33 and normal stress of 50 kPa.

D. Separation Fabric Nonwoven geotextile made from needle punched or heat-bonded polypropylene or polyester staple or continuous fiber. Alternative to these materials and manufacturing processes may be approved by the Engineer. Conformance to the following properties shall be according to ASTM D 4759 and referenced standard test methods:

1. Grab Tensile Strength (Min): 890 N; ASTM D 4632.
2. Tear Strength (Min): 355 N; ASTM D 4533.
3. Puncture Resistance (Min): 355 N; ASTM D 4833.
4. Apparent Opening Size (Max): 0.18 mm; ASTM D 4751.

2.3 EXCAVATION SUPPORT AND PROTECTION SYSTEMS

A. Materials need not be new, but must be suitable and fit for purpose, in serviceable condition and acceptable to the Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shore, support and protect buildings, structures, utilities, sidewalks, pavements, and other facilities, on or adjacent to the Project site, from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect sub grades and foundation soils. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared sub grades, and from flooding Project site and surrounding area.

B. Protect sub grades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system to keep sub grades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXCAVATION SUPPORT AND PROTECTION

A. Design, provide, install, monitor, and maintain at the Contractor's sole risk and responsibility, excavation support and protection systems capable of resisting soil and hydrostatic pressure and supporting sidewalls of excavations.

1. Work includes removing when no longer needed.

2. Install and remove without damaging existing structures, utilities, pavements, and other facilities adjacent to excavations.

B. Install excavation support and protection systems as excavation works proceed, in a manner acceptable to the Engineer.

1. Locate clear of permanent construction to permit access for subsequent construction operations and inspections.

2. Trim excavation as required and fill voids behind with soil, and compact.

C. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure excavation support and protection remains stable.

D. Remove excavation support and protection systems when construction has progressed sufficiently. Remove in stages to avoid disturbing underlying soils and damaging adjacent structures, utilities, pavements and other facilities.

E. Promptly repair or replace as directed and approved by the Engineer, adjacent work, structures, utilities, pavements and other facilities, damaged or displaced by installing or removing excavation support and protection systems.

3.4 EXCAVATION, GENERAL

A. **Unclassified Excavation**: Excavation to sub grade elevations regardless of the character of surface and subsurface conditions encountered, including rock, soil materials, boulders, and obstructions.

1. If excavated materials intended for backfill, fill, embankment, or sub grade layer include unsatisfactory soil materials and rock, replace with satisfactory soil materials, as applicable.
2. Excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other encountered items indicated or directed to be removed; together with other materials not classified as unauthorized excavation; including intermittent drilling, blasting if permitted, ram hammering, ripping and other acceptable means and methods.
3. Excavation includes removal and disposal of unsatisfactory soils and any surplus satisfactory soils.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 25 mm. Extend excavations a sufficient distance from permanent structures for working space requirements. Place blinding concrete, where indicated, immediately after excavating to final grades.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement or concrete. Trim bottoms to required lines and grades to leave solid base to receive other work.
2. 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 25 mm. Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR PAVEMENTS AND SITE IMPROVEMENTS

A. Excavate surfaces under roadways, parking lots, walks, pedestrian pavements, lawns, planted areas and the like, to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Set out trenches so that they do not encroach below a line drawn at an angle, from the horizontal of the nearest lower edge of any adjacent building foundation, as follows:
   a. In Dry Stable Soils: 45 degrees.
   b. In Wet Clays, or Soils Below Water Table: 30 degrees.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 300 mm higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 300 mm on each side of pipe or conduit, unless otherwise indicated.

C. **Trench Bottoms**: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape sub grade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench sub grade.

1. For pipes and conduit less than 150 mm in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed sub grade.

2. For pipes and conduit 150 mm or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.

3. Excavate trenches 150 mm deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. **Trench Bottoms**: Excavate trenches 100 mm deeper than bottom of pipe elevation to allow for bedding course. Remove projecting stones and sharp objects along trench sub grade. Hand excavate for bell of pipe.

1. Excavate trenches 150 mm deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.8 APPROVAL OF SUBGRADE

A. Notify the Engineer when excavations have reached required sub-grade.

B. If the Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill, fill or sub-grade layer material as applicable, and as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Proof rolls expansive sub-grade areas with heavy pneumatic tired equipment to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated sub-grades.

D. Reconstruct sub-grades damaged by rain, accumulated water, or construction activities, as directed by the Engineer.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by the Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by the Engineer.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrows materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for record documents.
3. Inspecting and testing underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.

3.12 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 450 mm of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Provide 100 mm thick, concrete-base slab support for piping or conduit less than 750 mm below surface of roadways and vehicular pavements. After installing and testing, completely encase piping or conduit in a minimum of 100 mm of concrete before backfilling.

D. Place and compact initial backfill of satisfactory soil material, free of particles larger than 25 mm, to a height of 300 mm over the utility pipe or conduit.

1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.

G. Place and compact final backfill of satisfactory soil material to final sub grade.

H. Install warning tape directly above utilities, 300 mm below finished grade, except 150 mm below sub grade under pavements and slabs.

3.13 FILL AND EMBANKMENT

A. **Preparation**: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fill and embankment material.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill and embankment material will bond with existing material.

C. Place and compact fill and embankment material in layers to required elevations as follows:

1. Under footings and foundations, use controlled fill.
2. Under building slabs, ramps and steps, use controlled fill.
3. Under roadways and vehicular pavements, use embankment material.
4. Under walks and pedestrian pavements, use satisfactory soil material.
5. Under lawns and planted areas, use satisfactory soil material.

3.14 MOISTURE CONTROL

A. Uniformly moisten or aerate sub grade and each subsequent backfill, fill or embankment layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill, fill or embankment material on surfaces that are muddy.
2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry density.

3.15 COMPACTION OF BACKFILLS, FILLS AND EMBANKMENT

A. Place soil materials in layers not more than 200 mm in loose depth for material compacted by heavy compaction equipment, and not more than 100 mm in loose depth for material compacted by hand-operated tampers.

B. Place soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact backfills and fills to not less than the following percentages of maximum dry density according to ASTM D 1557:

D. Compact backfills and fills to not less than the following percentages of maximum dry density according to ASTM D 698:

1. Under structures, building slabs, ramps and steps, scarify and recompact top 300 mm of existing sub grade and each layer of backfill or fill material at 100 per cent.

2. Under walks and pedestrian pavements, scarify and recompact top 150 mm below sub grade and compact each layer of backfill or fill material at 100 per cent.

3. Under lawns or unpaved areas, scarify and recompact top 150 mm below sub grade and compact each layer of backfill or fill material at 85 per cent.

3.16 GRADING

A. **General**: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. **Site Grading**: Slope grades to direct water away from buildings and to prevent ponding. Finish sub grades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 25 mm.

2. Walks and Pedestrian Pavements: Plus or minus 25 mm.

3. Roadways and Vehicular Pavements: Plus or minus 25 mm.

C. **Grading inside Building Lines**: Finish sub grade to a tolerance of 13 mm when tested with a 3 m straightedge.

3.17 SUBSURFACE DRAINAGE

B. **Subsurface Drain**: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 150 mm course of filter material on drainage fabric to support drainage pipe. Encase drainage pipe in a minimum of 300 mm of filter material and wrap in drainage fabric, overlapping sides and ends at least 150 mm.

1. Compact each course of filter material to 95 percent of maximum dry density according to ASTM ASTM D 1557.

C. **Drainage Backfill**: Place and compact filter material over subsurface drain, in width indicated, to within 300 mm of final sub grade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 150 mm.

1. Compact each course of filter material to 95 percent of maximum dry density according to ASTM D 1557.

2. Place and compact impervious fill material over drainage backfill to final sub grade.

3.18 DRAINAGE COURSE

A. Under slabs-on-grade, install drainage fabric on prepared sub grade according to manufacturer's written instructions, overlapping sides and ends. Place drainage course on drainage fabric and as follows:

B. Under slabs-on-grade, place drainage course on prepared sub grade and as follows:

1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry density according to ASTM D 1557

2. When compacted thickness of drainage course is 150 mm or less, place materials in a single layer.

3. When compacted thickness of drainage course exceeds 150 mm, place materials in equal layers, with no layer more than 150 mm thick or less than 75 mm thick when compacted.

3.19 FIELD QUALITY CONTROL

A. **Testing Agency**: Engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test sub grades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Foundation and Footing Sub grades: At foundation and footing sub grades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing sub grades may be based on a visual comparison of sub grade with tested sub grade when approved by the Engineer.

D. Testing agency will test compaction of soils in place according to ASTM D 698, ASTM D 1556, ASTM D 1557, ASTM D 2167, ASTM D 2922, ASTM D 2937, ASTM D 4429, and AASHTO T 180, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At sub grade and at each compacted fill and embankment layer, at least one test for every 200 sq. m or less of each type of paved area or building slab, but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 30 m or less of wall length, but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 50 m or less of trench length, but no fewer than two tests.

E. When testing agency reports that backfills, fills, sub grades, or embankments have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace with satisfactory soil to depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

A. **Protecting Graded Areas**: Protect newly graded areas from traffic, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. **Disposal**:

a. Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and dispose of at designated spoil areas on the Employer's property shall be disposed outside the site premises to any lead and lift or as directed by the Engineer.

b. Transport surplus satisfactory soil to designated storage areas on Employer's property. Stockpile or spread soil as directed by the Engineer.

END OF DOCUMENT

SECTION 15 - TERMITE CONTROL

PART 1 – GENERAL

A. General provisions of the Contract, including Conditions of Contract apply to this Section.

1.1 SUMMARY

A. This Section includes the following for termite control:

1. Termite prevention
2. Soil treatment
3. Wood protection

1.2 TERMITE PREVENTION

A. Avoid creation of conditions that invite termites wherever possible. Take the following measures:

1. Remove stumps, roots, wood, and other cellulose materials from the building site before commencing construction.
2. Remove cellulose materials from around the foundation before final backfill.
3. Promptly remove form boards and grade stakes used in construction from site.
4. Allow no contact between building woodwork and soil or fill material.
   a. Locate exterior woodwork a minimum of 15 cm above ground and beams in crawl spaces at least 45 cm above ground to provide ample space to make future inspections.
   b. Make foundation areas accessible for inspection if possible.
   c. If wood that contacts the soil, such as fence posts and foundation elements, use pressure treated wood.
5. Design ventilation openings in foundations to prevent dead air pockets and to help keep the ground dry.
6. Direct water away from the structure through proper grading.
7. Assure that the roof drainage system directs all water away from the foundation.
8. Avoid plantings near the foundation. Any tree that has the potential to grow to a height of 12 meters or taller shall not be planted within 15 meters of the foundation.

1.3 DEFINITIONS

A. EPA: United States Environmental Protection Agency.

B. PMP: Pest Management Professional

1.4 SUBMITTALS

A. Product Data: For termiticide and borate.

1. Include the EPA-Registered Label for termiticide and borate products.

B. Product Certificates: For termite control products, signed by product manufacturer.

C. Qualification Data: For Installer of termite control products.

D. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

E. Wood Treatment Application Report: After application of borate is completed, submit report for Owner's record information, including the following:

1. Date and time of application.
2. Brand name and manufacturer of borate.
3. Quantity of undiluted borate used.
4. Dilutions, methods, volumes, and rates of application used.
5. Areas of application.

F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A PMP who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this

   Project and whose work has a record of successful in-service performance.

B. Regulatory Requirements: Formulate and apply termiticide, and label with a US EPA registration number, to comply with EPA regulations and authorities having jurisdiction.

C. Document any applicable local codes or authorities and ensure that all relevant work is in compliance.

D. Implement applicable provisions of the Quality Control program as established in Section "Contractor Quality Control."

1.6 PROJECT CONDITIONS

TERMITE CONTROL SECTION -18

Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.7 COORDINATION

A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction

1.8 WARRANTY

A. Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, retreat soil and repair or replace damage caused by termite infestation.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 TERMITICIDES

A. Soil Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or amusable, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation for review and acceptance by the COR.

1. The Department of State currently authorizes Termidor and Premise as soil termiticide.
2. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA Registered Label.

B. Wood Protection Termiticide:

1. Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation for review and acceptance by COR.
2. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA Registered Label.

END OF DOCUMENT

SECTION 16

PART 1 -GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract.

1.02 SUMMARY

A. This Section includes standard aggregate concrete floor toppings applied over previously placed base slabs.

1.03 SUBMITTALS

A. Furnish product data, samples laboratory test reports, and materials certificates as per Engineer instructions. Allow fourteen (14) days for Engineer review.

PART 2 -PRODUCTS

2.01 CEMENT AND AGGREGATES

A. Portland Cement: ASTM C 150, Type I.

B. Normal Weight Aggregate: ASTM C 33: Fine aggregate, consisting of sand or crushed stone screenings, clean hard, free of deleterious matter.

2.02 TOPPING MIX

A. Standard Topping: Design mix to produce topping material with the following characteristics:

1 Compressive strength: 3500 psi at 28 days.

2 Slump: 200mm maximum at point of placement for concrete containing high-range water-reducing admixture (super-plasticizer) and 75mm maximum for other concrete.

3 Maximum W/C ratio: 0.51.

2.03 MIXING

A. Provide batches type mechanical mixer for mixing topping material at Project site. Equip batch mixer with a suitable charging hopper, water storage tank, and a water-measuring device. Use only mixers that are capable of mixing aggregates, cement, and water into a uniform mix within specified time, and of discharging mix without segregation.

B. Mix each batch of 2 cu. m or less for at least 1-1/2 minutes after ingredients are in mixer. Increase mixing time 15 seconds for each additional cu. m or fraction thereof.

1. Ready-mixed topping may be used complying with requirements of ASTM C 94.

PART 3 -EXECUTION

3.01 CONDITION OF SURFACES

A. **Topping Applied to Fresh Concrete**: Do not begin placement of topping until water ceases to rise to surface, and water and laitance have been removed from base slab surface.

1. When base slab surface is unacceptable for good bonding, roughen surface by chipping or scarifying before cleaning. Prior to placing topping mixture, thoroughly dampened slab surface but do not leave standing water. Over dampened surface apply good quality bonding compound as approved by the Architect or epoxy adhesive. Place topping mix after bonding compound has dried or epoxy adhesive is still tacky.

B. **Joints**: Mark locations of joints in base slab that joints in top course will be paced directly over them.

3.02 PLACING AND FINISHING

A. **Trowel Finish**: After floating, begin first trowel finish operation using power driven trowels. Continue troweling until surface is ready to receive final troweling, begin final troweling when a ringing sound is produced as trowel is moved over surface.

B. Continue final trowel operation to produce finished surface free of trowel marks, uniform in texture and appearance, and achieving and F/F of 25 and F/L of 20 tolerances when tested in accordance with ASTM E 1155.

C. Where joints are required, construct to match and coincided with joints in base slab. Provide other joints as shown.

3.03 CURING AND PROTECTION

A. Cure and protect topping applications and finishes as specified in Section "26 Concrete"

3.04 PERFORMANCES

A. Failure of concrete topping to bond to substrate (as evidenced by a hollow sound when tapped), or disintegration or other failure of topping to perform as a floor finish, will be considered failure of materials and workmanship. Repair or replace toppings in areas of such failures, as directed.

3.05 MATERIAL

A non-toxic solvent free high build, protective epoxy resin coating.

A. **Primary Uses**:

For the internal protection of concrete.

As an impervious, resilient and chemically resistant floor.

As a protective and decorative coating in the project.

B. Appearance and finish: The material should be High, gloss, heavy bodied, ultra dense surface. Hygienic and easily cleaned. Standard colours should be light and dark grey.

D. **It must have the following Advantages**

Durable

Non-toxic

Waterproof and protective

High chemical resistance

Solvent free

Easily applied by brush or roller.

E. **Typical properties**

Pot life at 30ºC	*30 minutes*
Mixed density	*1.6gm/cm² at 25ºC*
Track free time	*Approx. 4 hours at 35ºC*
Initial cure:	*12 hours at 30ºC*
Final cure:	*4 days at 30ºC*
Coverage:	*0.29 - 0.40kg /m² /coat*
Finish film thickness:	*180 - 240 microns per coats*
Bond to concrete	*In excess of the cohesive strength of concrete*

F. The Product must be Approve by Engineer. Water Researched Approval for use with Potable Water.

G. **Application Procedure**:

1. Surface preparation: The substrate should be a smooth or semi-smooth sound surface such as concrete or metal. It is most important to ensure that thorough surface preparation is undertaken prior to application of the protective epoxy resin coating.

a. Concrete:

Ensure concrete is free from excessive laitance, grease, oil, curing compound, etc. Ensure concrete is sound, cutting back where necessary and making using good protective epoxy resin compound. Ensure all blow holes and surface imperfections are made good prior to the application.

MASTERSEAL 180 coating.

Ensure concrete is at least 28 days old. Contamination by oil, grease, fats etc. must be removed before other forms of preparation begin. Remove laitance to expose blow holes, by light grit blasting.

b. Steel:

All previous surface treatment should be removed taking the surface back to base metal. The base metal should be abraded and preferably shot blasted with grit, steel shot or propriety abrasive. Where shot blasting is impractical pre-treatment may be carried out with preumatic de-scaling guns, tap hammers, rotary wire brushes or by flame scaling.

c. Mixing:

MASTERSEAL 180 is supplied in two pre-weighed components, base and reactor, or use any other material approved by the Architect. No additions or omissions are required. Add reactor contents to the base component and mix thoroughly for using a slow speed drill fitted with a suitable mixing paddle until a uniform streak free colour is achieved.

H. Application: MASTERSEAL 180 (or any other good quality material approved by the Architect) coating should be applied using good quality rollers or short haired brushes or by airless spray. It is recommended that MASTERSEAL 180 coating be applied in two coats of contrasting colours to ensure complete coverage.

Prior to the application of each coat the surface should be examined for signs of pin-holing, etc. Where pin-holing is evident these should be filled using CONCRESIVE 2200 thixotropic epoxy resin filler, or equivalent as approved by the Architect.

If the application is delayed more than 16 hours at 40ºC or 36 hours at 20ºC after the previous coat (the higher the ambient temperature, the shorter the maximum period), then the previous coat must be thoroughly abraded to give an adequate mechanical key and solvent wiped.

1. Airless Spray:

For application by airless spray, use a 45.1 or higher ratio pump, minimum 9mm dia hoses and HD tip 19-23 thou.

2. Over coating:

Where areas need to be over coated due to damage etc. it is important that the areas to be treated are well abraded using a stiff rotary wire brush or coarse sand paper to give an adequate key. Completely strip off any unsound coating and proceed with over coating as for new work.

I. Chemical resistance MASTERSEAL 180 or other material (approved by the Architect) should be resistant to the following typically encountered chemicals:-

a. Formaldehyde, 40% solution

b. Sulphuric Acid, 50% solution

c. Hydrochloric Acid, 50% solution

d. Lactic Acid, 50% solution

e. Nitric Acid, 10% solution

f. Sodium Hydroxide, 50% solution

g. Diesel oil Wine

h. Sea and brackish water

i. Aviation hydraulic fuels (Skydrol)

j. Vegetable oils

J. Specification Clause MASTERSEAL 180: Where indicated, apply MASTERSEAL 180 protective epoxy coating as manufactured by MBT or similar approved to the following specification:

Composition: Two component, non-toxic, pigmented solvent less a epoxy resin based compound.

Coverage: 0.29 to 0.40kg/m²/coat, two coats are recommended.

Dry film thickness: 180 to 240 microns/coat.

K. Storage Store under cover out of direct sunlight and protect from extremes of temperature. In tropical climates the product must be stored in an air conditioned environment. Failure to comply with the recommended storage conditions may result in premature deterioration of the product or packaging. For specific storage advice consult the Architect.

L. Safety Precautions As with all chemical products, care should be taken during use and storage to avoid contact with eyes, mouth, skin and foodstuffs. Treat splashes to eye and skin immediately. If accidentally ingested, seek immediate medical attention. Keep away from children and animals. Reseal containers after use. For further information, refer to material safety data sheet.

3.06 ACCEPTED MATERIALS

A. TASKI H-16 (Pore Filter, Based on Acrylic Polymer)

B. FOSROC FC-100

C. MASTERSEAL 180

D. Or Equal as Approved by the Architect.

3.07 SPECIAL NOTE

The hardener topping is carried out in 2 stages

A. Stage 1: Apply powder based hardener as detailed in Clause 2 & 3.

B. Stage 2: Apply dust proofing as detailed in Clause 3.05 / 3.06. The stage 1 & 2 are complimentary to each other.

END OF DOCUMENT

SECTION 17 - CEMENT-BASED SCREED

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:

1. Standard aggregate concrete leveling floor screeds.
2. Roof screeds necessary to provide roof slopes.

B. Related Sections include the following:

1. Division 7 Section "Joints Sealants".
2. Division 9 Section "Resinous Flooring".
3. Division 9 Section “Ceramic Tiles”.

1.3 DEFINITIONS

A. **Screed**: A layer of cement-sand or concrete mix, with or without reinforcement, applied over structural floor or roof deck slab to achieve correct level and receive another finish material.

1.4 SUBMITTALS

A. **Product Data**: For each type of product indicated.

B. **Mix Design and Test Reports**: For each mix used for screeds.

C. Joint details and arrangements.

D. Test reports for field control testing.

1.5 QUALITY ASSURANCE

A. Quality System: Comply with ISO 9001/9002 Quality System as a minimum. Incorporate all the standard procedures supplied by the Engineer and the Employer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer’s labels indicating brand name and directions for storage, mixing with other components, and application.

B. Store materials to comply with manufacturer’s written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 PROJECT CONDITIONS

A. **Environmental Limitations**: For proprietary products, comply with manufacturer's written recommendations for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting screed performance.

B. Close areas to traffic during screed application and for appropriate time period after application as recommended in writing by the manufacturer.

1.8 COORDINATION

A. Coordinate cement-based screed with requirements of finish flooring products, including adhesives, specified in Division 9 Sections.

PART 2 - PRODUCTS

2.1 SCREED MATERIALS

A. **Cement**: ASTM C 150, Type I, ordinary Portland cement.

B. **Normal-Weight Aggregate**: ASTM C 33 and as follows:

1. Fine aggregate, consisting of sand or crushed stone screenings, clean, hard, free of deleterious matter. Grade according to approval design mix.

2. Coarse aggregate, consisting of gravel or crushed stone, clean, hard, free of deleterious matter. Grade according to approval design mix.

C. **Water**: Potable and at a temperature of not more than 21 deg. C.

2.2 REINFORCEMENT

A. **Fibrous Reinforcement**: 100% virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Proportion shall be in accordance with the written manufacturer instructions of the manufacturer.

1. Specific Gravity: 0.91.

2. Tensile strength: 345 - 758 N/mm^2.

B. **Galvanized Plain-Steel Welded Wire Fabric**: For screeds 70 mm deep and more is to be electrically welded, fabricated from galvanized steel wire into flat sheets, 150 x 150 mm mesh and 3.00 mm minimum wire diameter.

2.3 CURING MATERIALS

A. **Absorptive Cover**: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 305 g/sq. m when dry.

B. **Water**: Potable.

2.4 DESIGN MIXES

A. Prepare design mixes for each type and strength of cement-based screed by either laboratory trial batch or field-test data methods. For trial batch method, use an approved qualified independent testing agency for preparing and reporting proposed mix designs.

B. Limit water-soluble chloride ions to the maximum percentage by weight of cement or cementitious material permitted by ACI 301.

C. Minimum Compressive Strength after 28 days is to be as follows:

1. 220kg/cm2 for screed with fine concrete mix (coarse aggregate of maximum size of 10 mm is used).
2. 180 kg/cm2 for cement-sand screeds.

2.5 RELATED MATERIALS

A. **Joint-Filler Strips**: ASTM D 1752, cork or self-expanding cork.

B. Water: Potable.

C. **Acrylic-Bonding Agent**: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. **Admixtures**: Admixtures certified by manufacturer to contain not more than 0.1 % water-soluble chloride ions by mass of cementitious material and compatible with other admixture and cementitious materials. Do not use admixtures containing calcium chloride.

E. **Epoxy Adhesive**: ASTM C 881, Type V, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

2.6 MIXING

A. **Bonding Slurry**: Mix 1 part Portland cement and 2 parts sand with water and an acrylic-bonding agent according to manufacturer's written instructions to a thick paint consistency.

B. **Screed Mix**: Design mix, with or without admixture, to produce a mix with the following characteristics:

1. Minimum Compressive Strength: As specified.
2. Maximum Slump: 125 mm.
3. Mix proportions: Submit proposed mix design for approval.
4. Minimum Cement-Sand Ratio: Not less than 1:4 by volume.
5. Maximum Water-Cement Ratio: 0.51.
6. Mix screed materials, admixtures and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for conditions affecting performance of screed. Proceed with application only after unsatisfactory conditions have been corrected.

B. Verify that base slabs meet finish and surface profile requirements in Division 3 Section "Cast-in-Place Concrete."

3.2 PREPARATION

A. **Existing Concrete**: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of 6 mm.

1. Prepare and clean existing base slabs according to topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.

2. Mechanically remove contaminants from existing concrete that might impair bond of topping.

B. Install joint-filler strips where screed abuts vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with screed surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips 13 mm below screed surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.

3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.3 SCREED APPLICATION

A. **Fibrous Reinforcement**: For screeds of depth less than 70 mm, apply fibrous reinforcing as per manufacturer's written instructions.

B. **Reinforcing Mesh**: Screeds 70 mm deep and more shall have a reinforcing layer at mid height. Reinforcement shall be as specified this Section. Place steel wire mesh with reinforcing wire parallel to longest dimension of screed bay. Cut mesh to fit around roof openings and projections. Terminate mesh at control joints. Lap sides and ends of mesh at least 150 mm.

C. **Deferred Screed**: Mix and scrub bonding slurry into dampened concrete to a thickness of 1.5 to 3 mm, without puddling. Place screed while slurry is still tacky.

D. Place screed continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.

1. Screed surface with a straightedge and strike off to correct elevations.

2. Slope surfaces uniformly where indicated.

3. Begin initial floating using bull floats to form a uniform and open-textured surface plane free of humps or hollows.

E. **Finishing**: Consolidate surface with power-driven floats as soon as screed can support equipment and operator. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate screed by power-driven trowel so no blisters develop. Continue troweling passes and restraighten until surface is smooth and uniform in texture.

a. Finish and measure surface so gap at any point between screed surface and an unleveled freestanding 3 m long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed 3 mm.

F. **Construction Joints**: Construct joints true to line with faces perpendicular to surface plane of screed, at locations indicated or as approved by the Engineer.

1. Coat face of construction joint with epoxy adhesive at locations where screed is placed against hardened or partially hardened screed.

G. **Contraction Joints**: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3 mm wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before screed develops random contraction cracks.

1. Form joints in screed over contraction joints in base slabs, unless otherwise indicated.

2. Construct contraction joints for a depth equal to one-half of screed thickness, but not less than 13 mm deep.

H. **Screed Mix**: Use cement-sand mix for screeds less than 70 mm in depth. Use fine concrete mix for 70 mm deep and more.

3.4 PROTECTION AND CURING

A. **General**: Protect freshly placed screed from premature drying and excessive cold or hot temperatures.

B. Begin curing immediately after finishing screed. Cure by one or a combination of the following methods, according to screed manufacturer's written instructions:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with water or absorptive cover, water saturated and kept continuously wet. Cover screed surfaces and edges with 300 mm lap over adjacent absorptive covers.

3.5 REPAIRS

A. **Defective Screed**: Repair and patch defective screed areas, including areas that have not bonded to concrete substrate.

3.6 FIELD QUALITY CONTROL

A. **Sample Sets**: At point of placement, testing and inspecting agency shall take a set of 3 molded-cube samples from the screed mix for the first 90 sq. m plus 1 set of samples for each subsequent 450 sq. m of screed, or fraction thereof, but not less than 6 samples for each day's placement. Samples shall be tested according to ASTM C 109M for compliance with compressive strength requirements.

3.7 CLEANING AND PROTECTING

A. Protect screeds from damage and wear during the remainder of construction period. Use protective methods and materials approved by the Engineer, including temporary covering.

B. Clean screeds not more than 4 days before dates scheduled for inspections intended to install final finishes.

END OF DOCUMENT