



SECTION 1 - GENERAL

1.1 Work covered by contract documents

- A. Project Identification: The “**KHARAYEB ELEVATED WATER TANK**” project comprises the construction, completion and maintenance during the defects liability period of a ground water tank with-inlet and outlet pipes from the main water network and to it. The project locates in **KHARAYEB**, South Lebanon.

SECTION 2 - EARTHWORKS

PART 1: GENERAL

2.1.1 Scope of Work

- A. This section covers trenching and backfilling work and shall include the necessary clearing, grubbing and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; backfilling; pipe embedment; surfacing and grading; and other related work.

2.1.2 Site Preparation

- A. Prior to commencing any excavation work, the Contractor shall establish a horizontal and vertical survey, record existing ground elevations and stake the location of structure to be excavated.
- B. The Contractor shall prepare the site for construction by clearing, removing and disposing of all items not indicated on the Drawings to remain or so defined by the Engineer.
- C. The Contractor shall obtain relevant excavation and road cutting permits as required to commencing work.

i) Existing Subsurface Structures and Utilities

- A. For all works required to deal with existing sub surfaces and utilities refer to General Section of these Specifications.

ii) Clearing, Grubbing and Grading

- A. The Contractor shall perform the clearing and grubbing (if any), of top soil consisting mainly of loose soil, vegetable and organic matters, drift sand, unsuitable soil and rubbish by scarifying the areas to be excavated and sidewalks to a minimum depth of 300 mm from the natural ground level. All materials resulting from the above operations shall be removed from the site, loaded and transported and off loaded, spread and leveled to approved dumps as directed by the Engineer.



2.1.3 Setting-Out

- A. The Contractor shall stake-out the work as shown on the Drawings and secure the Engineer's approval of his stake-out before proceeding with construction. If, in the opinion of the Engineer, modification of the line or grade is advisable before or after stake-out, the Engineer will issue detailed instructions in writing to the Contractor for such modification and the Contractor shall revise the stake-out for further approval in accordance with the relevant Clause of the Conditions of Contract.

2.1.4 Excavation

- A. The Contractor shall perform all excavation true to lines, widths and depths shown on the Drawings or to such further lines, depths or dimensions as may be directed by the Engineer.
- B. Excavation work will be done in all kinds of soils.

a) Road along the line.

- A. Wherever necessary the Contractor shall prepare a road along the line at such distance from the line that the traffic on the road will in no way interfere with pipe laying work. The Contractor shall also prepare access roads from the highway or other public roads to the said access road.
- B. The road along the line and the access roads shall permit the normal movement of trucks and other vehicles and all equipment and plant required for the execution of the works.
- C. The employer's employees shall at times have the use of the roads prepared by the Contractor, free of charge.
- D. The Contractor shall maintain the road along the line and the access roads in a good and serviceable condition and shall make all repairs that may be necessary during the whole period of construction.

b) Excavation to reduce levels.

- A. Wherever shown on the drawings, the Contractor shall reduce the ground level on the trench site and for tank foundation, prior to commencement the excavation of trench tank foundation. Before starting excavation for reducing of levels the Contractor shall move the marking of the alignment to such a distance that the marks will not be destroyed and will not interfere with the execution of the work.
- B. Excavation for reducing levels shall be done to the lines and levels shown on the drawings. Where the depth of excavation is not so shown it shall be done to a line parallel to the trench bottom in the section concerned.

c) Storing of Suitable Excavated Material

- A. During excavation, materials suitable for backfill and fill will be stockpiled on the site at sufficient distance from the sides of the excavation to avoid over-loading and prevent cave-ins or mixing with the concrete.

d) Disposal of Unsuitable and Surplus Excavated Material

Upon the order of the Engineer, all unsuitable and surplus materials shall be immediately removed, loaded and transported off the Site area by the Contractor to approved dumps and he shall abide by the relevant local regulations.

**e) Unauthorized Excavation**

- A. If the bottom of any excavation is taken out beyond the limits indicated or prescribed, the resulting void shall be backfilled by well graded material at the Contractor's expense with thoroughly compacted to an acceptable proctor as directed by the Engineer, if the excavations are for a structure or a manhole , then the void should be filled by cyclopean concrete.

f) Mechanical Excavation

- A. The use of mechanical equipment must be jointed with the approval of the Engineer. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts or other existing property, utilities or structures above or below ground. In all such locations hand excavation shall be used. The Contractor will be held responsible for making good at his own cost all additional damage to road surfaces and private lands caused by the use of mechanical excavators.

g) Alignment and Minimum Cover

- A. The alignment of each pipeline shall be fixed and determined from offset stakes. Horizontal alignment of pipes and the maximum joint deflection used in connection therewith shall be in conformity with requirements of the section covering installation of pipe.
- B. Pipe grades or elevations are not definitely fixed by the Contract Drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 900mm for diameters 150mm and above, 700mm for diameters less than 150mm or as mentioned in the bill of quantities. Greater pipe cover depths may be necessary at certain locations, the locations and depths will be determined by the Engineer, and will be followed by the Contractor. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finish ground or pavement surface elevation except where future surface elevations are indicated on the Drawings. Where there is no adequate minimum cover, concrete encasement will be used as hereinafter and as shown on the Drawings and as directed by the Engineer.

h) Excavation in Confined Areas.

- A. In confined areas, where the passage of excavating equipment is impossible, or where the Engineer deems to use of such equipment impracticable or undesirable for any reason whatsoever, trench excavation shall be done by hand. All requirements specified above for common or sand excavation shall also apply to trench excavation by hand.

i) Padding of Trench Bottom.

- A. Wherever the trench bottom is in rock or where the Engineer will decide that the trench bottom is unsuited for laying of pipe on it, the trench will be excavated to an additional depth, and the Contractor shall pad the trench bottom with a layer 100 mm thick of selected excavated material not containing stones larger than 30 mm measured in any direction provided that the quantity of stones smaller than 30 mm is not more than 20% by volume.
- B. The surface of the padding shall be finished to grade as specified above so as to provide an even and solid support for the pipes to be laid.



2.1.5 Backfilling of Trenches

i) General

- A. Every section of the pipeline shall be covered as soon as possible after being lowered into trench, but no section of the line shall be covered without express approval of the Engineer. Each section shall be backfilled after the pipe has been placed in its final position on the trench bottom and after all weld joints and bends have been coated and all defects in the pipe coating repaired.
- B. Backfilling shall be done carefully to prevent displacement of the pipe or injury to the pipes and their coating. The backfill material shall completely fill the entire space between the pipe and the trench surfaces, without leaving any voids.
- C. Care shall be taken that the backfill material does not contain any electrodes, scrap iron, fragments of timber or shrubs, roots, broken skids, tyres, ashes, refuse, oil or soil soaked with oil. Stones removed during trench excavation may be used in the second stage of backfilling as specified below.
- D. On hillsides or sloping ground, furrows or terraces shall be provided across the pipeline trench to direct the flow of rainwater into the natural drain courses and away from the pipeline trench.
- E. Where the pipeline crosses natural drainage channels, an opening in the backfill shall be made to avoid interference with normal drainage of the surrounding land.
- F. Backfilling shall be done so as not to spoil the road or disrupt its continuity.

ii) Backfilling of Trenches in Cross-Country Areas

Where the pipes are laid cross-country, the backfilling of trenches shall be done as follows:

- A. **Soft Backfill** (surrounding the pipe) shall consist of sand from any approved source or fine aggregates. This material shall be placed 200 mm below the invert level up to 200 mm over the crown of the pipe and for the full width of the trench, or to the depths specified in the Bill of Quantities.
- B. **Final Backfill** for the remainder of the trench shall be by using well graded approved backfill material. (as specified herein after in paragraphs 2.11(i , ii))
- C. The trench shall be filled to the level of the natural adjacent ground level in layers not exceeding 200 mm, wetted and compacted by rolling, tamping to 90 percent of maximum dry density. If rolling is employed, it shall be by use of a suitable roller or tractor, being careful to compact the fill throughout the full width of the trench.
- D. Other layer of the same material shall be mounded 150 mm above the existing grade or as directed by the Engineer.

iii) Backfilling of Trenches in or Adjacent to Streets

Where the pipes are laid in or adjacent to streets, the backfilling of trenches shall be done as follows :

- A. **Soft Backfill** shall be done as specified above in paragraph 2.9(ii-A)
- B. **Final Backfill** for the remainder of the trench shall be by using well graded approved backfill material. (as specified herein after in paragraphs 2.11(i , ii))



- C. The selected backfill shall be up evenly on all sides, in layers not exceeding 200 mm measured before compaction, thoroughly wetted and compacted by rolling, tamping, or vibrating with mechanical compacting suitable equipment or hand tamping, to 95 percent of maximum dry density. Where these methods are not practicable, compaction shall be done by using of pneumatic ramming with tools weighing at least 10 Kg. The materials in this case being spread and compacted in layers not more than 150 mm in thickness. If necessary, sprinkling shall be employed in conjunction with ramming.
- D. The top 200mm sub-base for pavement replacement, shall consist of one layer of approved base course material, wetted and compacted to 95 percent of maximum dry density.
- E. Should the contractor wish to use the material excavated from the trench as sub-base for pavement replacement, the contractor shall at his own expense have samples of the material tested by an independent and certified laboratory at intervals not to exceed 150 m, in order to establish its compliance with the specifications. Only material which has been tested by the contractor and approved by the engineer shall be allowed to be incorporated into the work.

iv) Backfilling of Trenches with Excessive Slopes

- A. On trenches with slopes exceeding 15 percent, a 300 mm wide, stone partitions shall be built across the trench every 10 meters length.
- B. These partitions shall be done constructed over the first stage of the backfill up to the natural ground level, and shall exceed the trench width with 200 mm from each side inside the ground.

v) Restoring Trench Surface

- A. Where the trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, the contractor shall thoroughly consolidate the backfill and shall maintain the surface as the work progress. If settlement takes place, he shall immediately deposit additional fill to restore the level of the ground. In some areas it may be necessary to remove excess materials during the clean-up process, so that the ground may be restored to its original level and condition.
- B. The surface of any driveway or any other area which is disturbed by the trench excavation and which is not a part of the paved road shall be restored by the contractor to a condition at least equal to that existing before work began.
- C. Where the pipes are laid in cross-country areas, and where the danger of erosion exists, the uppermost 300 mm part of the trench may be backfilled with common backfill material containing fragments of ledge and boulders smaller than 150 mm providing that the quantity in the opinion of the Engineer is not excessive. Small stones and rocks shall be placed in thin layers alternating with earth to insure that all voids are completely filled.
- D. All road surfaces shall be broomed and hose-cleaned immediately after backfilling. Dust control measures shall be employed at all times.

2.1.6 Backfilling around Structure

i) General

- A. Surfaces to receive backfill shall be cleared of debris and unsatisfactory materials prior to the placement of the backfill material



- B. When the top 200mm of surface to receive backfill has a density less than the required maximum dry density, break up surface, pulverize, moisten and compact such that the required degree of compaction is achieved to form a “compacted subgrade”.
- C. Backfill excavations as promptly as the work permits, but not until completion of inspection, testing, approval, and recording of location of underground utilities, as required.

ii) Backfilling - Common Fill

- A. Common Fill may be used as fill against exterior walls of structure as indicated on the drawings. Materials conforming to the requirements of common backfill shall be placed in layers having a maximum thickness of 200 mm measured before compaction, each layer of fill or backfill shall be moistened or aerated and compacted to at least 90 percent of maximum dry density, or as specified in the Bill of Quantities.
- B. Backfill or fill materials shall not be placed on surfaces that contain excessive moisture, preventing specified degree of compaction.
- C. Material placed in fill areas shall be deposited to the lines and grades shown on the drawings making due allowance for settlement of the material.
- D. No compacting shall be done when the material is too wet either from rain or from excess application of water. At such cases, work shall be suspended until previously placed and new materials have dried sufficiently to permit proper compaction.

iii) Backfilling - Structural Fill

- A. Structural fill shall be placed in layers having a maximum thickness of 200 mm in open areas and 150 mm in confined areas including points where conduit and piping join structures, measured before compaction. Each layer shall be moistened or aerated and compacted to at least 95 percent of maximum dry density, or as specified in the Bill of Quantities, by methods approved by the Engineer. The limits of structural fill adjacent to structures shall extend as shown on the drawings.
- B. Compaction of Structural fill in open areas shall consist of fully loaded ten-wheel trucks, a tractor dozer weighing at least 13.5 ton and operated at full speed, a heavy vibratory roller, or any method approved by the Engineer.
- C. Compaction of structural fill in confined areas shall be accomplished by hand operated vibratory equipment or mechanical tampers approved by the Engineer.

2.1.7 Material Used in Backfill

i) General

- A. Backfill and fill material shall be suitable excavated material, natural or processed mineral soils obtained from off-site sources, or graded crushed stones or gravel.
- B. Backfill and fill material shall be free from all organic material, trash, snow, ice, frozen soil, or other objectionable material which can't be properly compacted. Soft, wet, plastic soils which may be expensive, clay soils having a natural in-place water content in excess of 30 percent, soil containing more than 5 percent (by weight) fibrous organic material, and soil having a plasticity index greater than 30 shall be considered unsuitable for use as backfill and fill material.
- C. Backfill and fill material shall have a maximum of one percent expansion when testing is performed on a sample remolded to 95 percent of maximum dry density at a two percent below optimum moisture content under a 490 kg/m² surcharge.

**ii) Common Backfill Material**

- A. Common Backfill or fill material shall not contain Granite blocks, broken concrete, masonry rubble, asphalt pavement, or any material larger than 150 mm in any dimension provided that this material is not more than 25 percent of the backfill or fill material.
- B. Common Fill shall have physical properties, as approved by the engineer, such that it can be readily spread and compacted.

iii) Selected Backfill Material

- A. Selected Backfill and Fill material shall conform to the requirements of common Backfill except that the material shall not contain any materials larger than 50 mm in its largest dimension provided that this material is not more than 20 percent of the Backfill or fill material.

iv) Crushed Stones

A. Crushed stones shall be sound, durable stone, angular in shape, and free of foreign material, structural defects and chemical decay. Crushed stones shall be of a maximum dimension of 50 mm and in a minimum of 12 mm measured in any direction.

2.1.8 Quality Assurance**Laboratory Testing**

- A. At least seven days prior to the placement of any Backfill or Fill material, the contractor shall deliver a representative sample of the proposed material weighing at least 22 Kg to an approved soils testing laboratory to perform:
 - A. Grain size analyses of the samples to determine their suitability for use as Backfill or Fill material in accordance to the material requirements specified in section 2.11
 - B. The appropriate Proctor analysis to determine the maximum dry densities required for compaction testing as specified in the contract documents.
 - C. The test results and determinations of suitability shall be delivered to the engineer no later than three days prior to the placement of Backfill or Fill materials.

2.1.9 Replacement of Pavements and Structures by the Contractor

- A. Unless otherwise shown on the Drawings or mentioned in the bill of quantities, the Contractor shall restore all pavements, sidewalls, sidewalks, curbs, gutters, shrubbery, fences, poles, sod, or other property and surface structures removed or disturbed as a part of the work to a condition equal to that before the work began, and shall furnish all incidental Labour and materials. No permanent pavement shall be restored unless and until, in the opinion of the Engineer, the condition of the backfill is such as to properly support the pavement and not before written approval from the Engineer to commence such works.
- B. Where pipelines pass underneath asphalted roads and parallel to the axis of the road, the final 250 mm of the trench backfill shall be furnished as follows:
 - 1. 200 mm (after compaction) shall be done by using approved base course material, placed, wetted and compacted to not less than 95 % of the modified Proctor density.



2. Spraying 2 kg of prime coat (MCO) per each square meter over the compacted base course, and applying a layer of asphalt mix of size in a thickness not less than 50 mm.

2.1.10 Measurement and Payment

- A. All Excavated material of whatever type shall be measured as “unclassified” which shall be deemed to include all materials encountered of any nature, including silts, clays, sand, gravel and granular materials and fractured, jointed and solid rock, and unsuitable material.
- B. Trench Excavation shall be measured, as classified in the Bill of Quantities, and trimmed to required line, grade and cross section, including depositing excavated material along the side of trench if directed or hauling away and wasting, stockpiling or depositing on or in the vicinity of the works completed and accepted.
- C. Measurement of Excavation for Manholes included in Manhole price.
- D. Measurement of Backfilling of trenches included in Excavation and Backfilling price.
- E. Soft Backfilling from the bottom of the trench to at least 200 mm above the crown of the pipe, with sand or fine aggregate fill as specified.
- F. Final Backfilling for the remainder of the trench above the zone around the pipe with selected fill material as specified.

Reinstatement of roads and paved surface shall be measured in squared meter. The work will include removal, restoration and maintenance of surfaces and property, preparation of road foundation and replacement of hard core, asphalted layer as indicated in the specification and the Bill of Quantities.

SECTION 3 : CONCRETE AND REINFORCED CONCRETE

3.1 General

- A. This section consists of furnishing all plant, equipment, appliances and materials and in performing all operations necessary in the construction in accordance with the Specifications, Drawings and Engineer's instructions and subject to the terms of the Conditions of Contract.
- B. Unless approved by the Engineer to mix the concrete on Site for small quantities, all types of concrete will abide with the requirements of :
 - a) ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials.
 - b) ACI 301 Structural Concrete for Buildings.
 - c) ACI 318 Building Code Requirements for Reinforced Concrete.
 - d) ACI 347 Recommended Practice for Concrete Formwork.
 - e) ASTM A 184 Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

and will be furnished to the site as ready mixed concrete supplied from an approved ready mixed plant. Contractor must obtain Engineer's approval of the concrete plant prior to the delivery of concrete from same.

- C. All concrete works shall be executed as exposed fair faced concrete and will abide with all requirements for same.
- D. All concrete casting will fully abide with "good" control conditions requirements and approved by the Engineer.

3.2 Material

i) Cement

- A. The cement shall be sulphate-resisting cement of local manufacturer meeting requirements with minimum strength 400kg/cm² after 28 days.

ii) Aggregate

Fine Aggregate

- A. Sand for concrete, mortar and grout shall be furnished by the Contractor from any approved source and shall be natural sand or a mixture of natural sand and fine crushed stone. The sand shall meet the requirements of ASTM C33, with the additional requirement that the specific gravity of the sand shall not be less than 2.50.
- B. Unless otherwise specified the sand shall be graded as shown in table 3.1 below:

Table 3.1

Sieve Size mm	Percentage Passing by Weight
4.75	100
2.36	80-100
1.18	30-75
0.60	25-60
0.30	10-30
0.15	0-10

**Coarse Aggregate**

- A. Coarse Aggregate for concrete shall be furnished by the Contractor from an approved source and shall consist of hard dense durable uncoated rock fragments and shall meet the requirements of ASTM C33 with the following limitations.
- B. The Los Angeles Abrasion test should not exceed 32% for grade B and 28% for grade A. Water absorption should not be more than 2.5 % more than the absorption of Bazelt aggregate retained an 9.5 mm sieve i.e. the total absorption should not exceed 3.5 % and the specific gravity shall not be less than 2.50. The grading of coarse aggregate shall be as shown in table 3.2 below:

Table 3.2

Nominal Sizes 19.0 mm	
Sieve Size mm	Percentage Passing by Weight
25.0	100
19.0	85-100
14.0	0-20
9.5	0-5
Nominal Size 25.0 mm	
Sieve Size mm	Percentage Passing by Weight
37.5	100
25.0	85-100
19.0	0-20
14.0	0-5

- C. The size of coarse aggregate used in any part of work shall be such that it does not contain any particles larger than 1/3 of the thickness of the thinnest concrete member or of the smallest distance between reinforcement bars whichever is smaller

Combined Aggregate

- A. The grading of combined aggregate shall be approximately as shown in table 3.3 below:

Table 3.3

Sieve Size mm	Percentage Passing by Weight		
	Grading No. 1	Grading No. 2	Grading No. 3
63	95-100	--	--
50	80-100	100	--
37.5	65-85	90-100	100
25	50-75	50-85	90-100
19	45-65	45-75	70-100
9.5	38-55	38-55	50-75
4.75	30-45	30-45	35-60
2.36	23-35	23-35	27-15
1.18	17-27	17-27	20-35



Sieve Size mm	Percentage Passing by Weight		
	Grading No. 1	Grading No. 2	Grading No. 3
0.3	4-9	4-9	5-15
0.15	1-7	1-7	1-5
0.075	0-5	0-5	0-5

iii) Water

- A. Water used in concrete either for mixing or curing shall be fresh potable water derived from an approved source of supply and shall be free from silt, oil, organic matter, acid, alkali-slare and other dexterous substances. The temperature of the water shall not be less than 10°C. the water shall meet the requirement of ASTM C94

iv) Reinforcing Steel

- A. The steel bars to be used are of plain and deformed steel bars complying with ASTM standards before bending the steel is to be straightened to the Engineer's satisfaction and cleaned of all rust loose mill scale, oil or any other dirt.
- B. Spacers shall be made of precast concrete cubes which shall match the concrete into which they are cast in every way (strength proportion, color) or as approved by the Engineer.
- C. Jointing of reinforcement bars shall be done with overlap no less than 50 times the diameter of the respective bar.

v) Additives

- A. Where required or approved by the Engineer, the Contractor shall use additives such as plasticizers or retarders in the concrete. Proportioning and mixing of additives thereof to be used in the concrete shall be in accordance with manufacturer's recommendations and subject to the Engineer's approval. Additives shall be added to the batch in solution in a proportion of the mixing water according to the manufacturer instructions. This solution shall be batched in such a manner as will ensure uniform distribution of the additive throughout the batch during the specified mixing period.
- B. Additives shall be suitable for use in contact with potable water after 30 days of concrete curing.
- C. The additives used shall be furnished by the Contractor, and the cost of the materials and all costs incidental to their use shall be included in the unit prices bid in the Bill of Quantities for concrete in which the materials are used.



3.3 Types and Strength of Concrete .

- A. Types and Strength of Concrete to be used in the works are as shown in table 3.4 below:

Table 3.4

Type	Cube Strength after 28 days [MPa]	Minimum Quantity of cement kg per m3 of concrete	Maximum Permissible Water/cement Ratio
C35	35	400	0.60

- B. Concrete type C35 shall be used as watertight for tank .
- C. The Contractor shall be free to fix the proportions of the mix provided that it could be demonstrated that the mixes used have the lowest possible water content consistent with proper grading and good workability for the sake of minimum drying shrinkage, and on condition that the Contractor can prove by advance testing carried out in approved laboratory, that they are suitable, comply with all the requirements of the specifications, and that they can be transported, placed and compacted by the methods and equipment used on site.

3.4 Forms and Shuttering

- A. All forms for casting of concrete shall be made of steel, plywood, mazonite or similar material providing a completely smooth surface of the face coming in contact with the concrete. Only new, strong and smooth timber shall be used for shuttering and scaffolding.
- B. The Contractor shall bear the sole responsibility for the safety and stability of the forms, scaffolds etc., and in the case of collapse, excessive deflections, buckling and /or any other changes in shape, the damage shall be repaired by the Contractor at his expense.
- C. Form ties shall be internal where possible. The typing of forms in the walls shall be made with special accessories fitted with cones or accessories of approved type by the Engineer so as to ascertain complete sealing after stripping of forms, and avoid any seepage of water at the ties. After the tie fittings have been removed, the holes shall be filled with epoxy on the inside and cement grout of the approved type by the Engineer on the external face.
- D. Forms shall be stripped only with the Engineer's approval. The minimum period from completion of casting to commencement of stripping will be as follows :
- Walls - 48 hours
- Roof - 14 to 21 days

3.5 Mixing and Placing of Concrete

- A. Contractor will have to submit for Engineer's approval a scheme of the proposed forms and shuttering as well as a detailed schedule for casting proceedings.
- B. Contractor must inform the Engineer of any scheduled casting at least 48 hours prior to the casting and must obtain Engineer's approval to the proposed schedule.
- C. When mixing on site is approved by the Engineer, concrete shall be machine mixed with approved machines.
- D. The location of the mixing plants shall be agreed on with the Engineer and the Contractor must submit to the Engineer for approval before erection of any mixing plant his proposed arrangements for the storing of aggregates, batching and mixing of the concrete.



- E. The placing of concrete in any element is to be carried out continuously without pause, in a manner which will not produce construction joints or cold joints due to partial drying of compacted concrete.
- F. The concrete transported by transit mixer or agitators, the time elapsing from the time water is added to the mix until the concrete is deposited in place shall not be greater than the time taken for 300 revolutions of the transit mixer or agitator or 20 minutes, whichever is the least.
- G. Driver of delivery trucks shall be provided with trip tickets, which shall be signed by a responsible member of the central plant staff, for submission to the Engineer. The ticket shall contain name and address of the central plant, serial number of the ticket and date, truck number, class and/or strength of concrete, cement content of the mix, loading time, slump and any other type of relevant information. The Engineer may send his representative to the central plant to check the batching and mixing, verify loading time and take a copy of the trip ticket.
- H. The placing of fresh concrete will be gently placed in position and will not be allowed if the free fall is more than 2.0m. Concrete shall not be placed in such a manner that it displaces reinforcing bars, ties, etc. The fresh concrete is to be placed in its final destination in accordance with the above mixing and batching procedures. Any concrete that has become so stiff that proper placing cannot be assured, shall be wasted.
- I. Concrete shall be consolidated to a maximum practicable density, by means of vibration, so that it is free from pockets of coarse aggregate and entrapped air, and closes snugly against all surfaces of forms, reinforcing steel bars and embedded materials. The slump for concrete thus consolidated must be fairly high and the cement quantity increased accordingly to achieve specified strength.

3.6 Joints

- A. Working joints in the concrete will be permitted only in places marked on the Drawings or as approved by the Engineer.
- B. Working joints will not be measured for payment and Contractor will incorporate their cost in the unit prices for concrete works.
- C. Joints with P.V.C water stops will be constructed as marked on the Drawings or requested by the Engineer.
- D. The water stops will be of P.V.C strips 240 x 4 mm. supplied by an approved manufacturer and approved by the Engineer. Contractor must furnish samples of water stop to be used along with the manufacturer's certificate specifying the characteristics and quality of the material.
- E. Engineer's approval of the sample does not release the Contractor from any responsibility to the quality of the material and the proper execution of the joint.
- F. Water stops will be furnished to the site as complete units having the shape and dimensions as indicated on the Drawings.
- G. The edges of the water stop will be joined by welding since no overlap will be permitted.
- H. The water stop will be inserted accurately in the elements of the structure cast first and will be properly protected from any damage, dirt or distortion of its shape and position. Prior to casting the adjoining part of the concrete element, face of the joint will be properly cleaned and a 3 mm. hot asphalt coat will be applied on the whole of the joint area. Sealing of joints shall be completed by filling the groove with an elastoseal pack as marked on the Drawings.



3.7 Concrete Repairs and Finish

- A. All repair works that might be required on sections of the cast concrete shall be performed by the Contractor not later than 24 hours after removing of forms.
- B. If not otherwise instructed, Contractor will cut all projecting tie wires to a depth of 15 mm, into concrete face and fill the recess with fresh concrete. Concrete projection caused by roughness of forms will be chiseled away or otherwise removed by a polishing carborundum stone. Gravel pockets, holes or faulty spots shall be chiseled out until clean and healthy concrete is exposed. All recesses shall be filled up with fresh concrete of approved cement grout and properly repaired. The repaired section will merge with the concrete of the structure and smoothed level with its surface.
- C. All repair works will be performed only after damaged part has been checked by the Engineer.
- D. All finish works shall be performed by the Contractor at his expense and he would not be entitled to any compensation for the same.

3.8 Construction of Manholes

i) General

- A. The Contractor shall construct manholes in reinforced cast-in-place concrete or in precast concrete rings to the levels, dimensions and shapes shown on the Drawings, or as directed by the Engineer.
- B. All manholes shall be constructed with incoming and outgoing pipes neatly and truly concreted in, complete with benching, cast iron steps and manhole cover and frame as here specified and shown on the Typical Drawings.

ii) Manholes

- A. The Contractor shall construct a well compacted blinding layer of plain concrete Type C30 to the required levels after the Engineer has inspected and approved bottoms of excavations. The surface of the blinding layer shall be regular and smooth.
- B. The Contractor shall set tops of manhole frames and covers to the elevations as indicated on Drawings, unless otherwise directed.
- C. All items built into walls of manholes and structures such as pipe ends shall be adequately sealed to obtain watertight construction to the satisfaction of the Engineer. Steps shall be installed in a staggered pattern to the extent indicated at not more than 300 mm centers and shall be well grouted.
- D. Changes in direction of gravity sewers shall be made through the use of a manhole.
- E. House connections shall be made to manholes using a piece of pipe called socket.
- F. Drilling shall be used when connecting pipes into manholes.
- G. Covers and frames shall be well centered and anchored all around to the approval of the Engineer.
- H. After the installation of the cast iron frames, the Contractor shall provide plain concrete Type C30 in surrounds as indicated on Drawings. Surrounds shall be well hunched all round and troweled smooth.
- I. Drop fittings : Drop manholes shall have drop pipes and fittings installed such that the crown of the incoming drop pipes shall be at the same elevation as that of the outgoing pipe. Drop pipes shall be of the same diameter as the incoming pipes. The drop pipes and fittings shall be encased in plain concrete Type C30 as indicated on the Typical Drawings.
- J. Benching to manholes shall be constructed in plain concrete, Type C35, well formed and streamlined and smooth trowelled in channels, bends and junctions.
- K. All manholes steps, covers and it's frames shall be well cleaned and painted with black paint of bituminous base after complete installation and to the approval of the Engineer.



- L. All manholes shall be properly ventilated as shown in the Typical Drawings.

iii) Cleaning

- A. All manholes shall be cleaned of any accumulation of silt, mortar, debris or other foreign matter and shall be free of any such accumulation at the time of final inspection.

3.9 Metal Components Embedded in Concrete

- A. All metal components that have to be fixed in the concrete such as pipe sections, steel frames and covers, hooks, ladders etc., shall be tightly placed in their right position within the shuttering prior to casting of concrete. All faces of metal parts that will be embedded in the concrete shall be thoroughly cleaned removing all dirt like, oil, paint, scale etc., in order to secure thorough adhesion between concrete and metal. Where pipes have to be anchored in the concrete, anchoring rings shall be welded to the pipe. In case a free passage of the pipe is required through the concrete, pipe should be wrapped with a bitumen saturated felt or a similar elastic sealing material.

3.10 Concrete Tests

- A. Concrete tests shall be carried out in accordance with ASTM C31 for samples, ASTM C 143 for slump, . Preliminary tests shall be made by the Contractor to determine suitable mixes. Routine tests shall be taken for cube strength according to ASTM standards.
- B. If the mean value of strength does not comply with the requirement of standards the particular structural element must be core tested, if the cores don't comply with the requirement , Engineer shall have the right to require strengthening or replacement of that element which fail to develop the required strength. All remedies associated costs shall be at the expense of the Contractor.
- C. All costs in connection with the tests shall be at the Contractors own expense.

3.11 Precast Elements

- A. Precast elements shall be either of concrete or mortar as shown on the Drawings and as specified hereinafter

i) Materials

a) Precast Concrete Elements

Precast concrete elements if exist shall be of plain or reinforced concrete dimensions, thickness and reinforcement rods and bars shown on the Drawings and stated in the Bill of Quantities.

b) Precast Mortar Elements

Moist tamped mortar precast elements shall be of a mixture of ordinary or tinted cement and sand (fine aggregate) approximately in the proportions of one part cement to two and one-half parts of sand. The sand shall be specially selected for color and grading. The sand shall be screened through 3mm square meshes and all oversize particles shall be discarded. Only sufficient water shall be used in mixing to permit the immediate removal of the member from the mould. The pattern, dimensions and thickness shall be as shown on the Drawings and/or as directed in writing by the Engineer.

**c) Mortar**

Mortar for joining the precast elements shall be composed of one part of portland cement and three parts of clean sand unless otherwise specified. The cement and sand shall conform to the requirements Portland cement and aggregate for mortar specified herebefore.

ii) Fabrication

- A. Precast concrete or mortar elements shall be cast in Mortar tight metal lined timber moulds and shall be mechanically vibrated when cast. The Precast elements shall be removed from the moulds as soon as practicable and shall be kept damp for a period of at least 10 days. Any elements that show checking or soft corners or surfaces shall be rejected. The method of storage and handling shall be such as to preserve true and even edges and corners, any precast element which becomes chipped, marred or cracked before or during the process of placing shall be rejected, sampling of precast elements shall be submitted to the Engineer for approval, prior to fabrication, at the Contractor's own expense.

iii) Workmanship

- A. All precast concrete or mortar elements shall be well cleaned and thoroughly wetted with clean water before placing in their positions shown on the Drawings. The precast elements shall be bedded and jointed in cement and sand mortar (1:3) mix and the joints raked out on both faces to receive plaster or pointing as indicated on the Drawings and/or stated in the Bill of Quantities to the satisfaction of the Engineer.

3.12 Measurement and Payment

- A. All concrete structures shall be measured as indicated in the Bills of Quantities.
- B. Ready-made manholes shall be measured for payment by number of units.
- C. All recesses, openings or any other space not actually filled with concrete shall be deducted in calculating the volume for payment. Any extra concrete which was cast due to the Contractor's negligence and is not marked specifically on the drawings shall not be measured for payment.
- D. Unit price quoted by Contractor shall include all works required to obtain designated concrete quality as well as supply of cement admixtures, and all aggregates, installing of forms and shutters and dismantling same, casting, vibrating, and compacting of concrete forming curved shapes as well as grooves or sleeves for pipes as may be required. Prices will include also taking samples, performing any laboratory tests that may be required by the Engineer and providing certificates of test results.
- E. Reinforcing steel shall be measured for payment as indicated in the Bills of Quantities. No overlaps, neither any odds or leftovers shall be counted as part of the total approved weight.
- F. Unit price for reinforcing steel shall include : supply, cleaning, bending, cutting, shaping, placing and tying of steel bars as well as overlaps, chairs and spacers.
- G. No payment will be due for working joints. Joints with water stops will be measured for payment in meter length of complete joint. Price shall include: supply of P.V.C water stop, placing, tying and jointing of water stop, applying of asphalt coat on joints face and protecting of exposed part of water stop.



PORTLAND CEMENT PLASTER

- PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Color for Finish Coats: White or Gray.

B. Colorants for Job-Mixed Finish-Coats: Colorfast mineral pigments that produce finish plaster color to match Architect's sample.

C. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.

D. Sand Aggregate: ASTM C 897.

1. Color for Job-Mixed Finish Coats: White.

E. Exposed Aggregates for Finish Coats: For marblecrete finish, clean, sound, crushed marble matching color and size gradation of Architect's sample.

F. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

- PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed **1 lb of fiber/cu. ft. (16 kg of fiber/cu. m)** of cementitious materials. Reduce aggregate quantities accordingly to maintain workability.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to

1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to

1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

C. Base-Coat Mixes for Use over Monolithic Concrete: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part **admixture for better workability**. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

D. Base-Coat Mixes for Use over Concrete Unit Masonry: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts **admixture for better workability**. Use 2-1/2 to 4 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

E. Job-Mixed Finish-Coat Mixes:

1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material (sum of separate volumes of each component material).

F. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters and acrylic-based finish coatings, comply with manufacturer's written instructions.



- EXECUTION

1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare solid-plaster bases that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3 INSTALLING NONSTRUCTURAL STEEL FRAMING, GENERAL

- A. General: Comply with requirements in ASTM C 1063 for applications indicated.
1. Comply with ASTM C 754 for installation of items not addressed in ASTM C 1063.
 - B. Install supplementary framing, blocking, and bracing at terminations in plaster assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
 - C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement.
 1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
 2. Isolate partition framing and wall furring where it abuts structure, except at floor. At head of assemblies, install slip-type joints that avoid axial loading and that support assembly laterally.
 - D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.
 - E. Soffits: Unless otherwise detailed on Drawings, install furred or suspended soffits to comply with requirements for ceiling installation; install framed soffits to comply with requirements for partition installation.

4 INSTALLING METAL LATH

- A. Expanded-Metal Lath: Install according to ASTM C 1063.
1. Partition Framing and Vertical Furring: Install flat diamond-mesh lath.
 2. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh lath.
 3. Curved-Ceiling Framing: Install flat diamond-mesh lath.
 4. On Solid Surfaces, Not Otherwise Furred: Install self-furring diamond-mesh lath.

5 INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.
- B. Reinforcement for External Corners:
1. Install lath-type external-corner reinforcement at exterior locations.
 2. Install cornerbead at interior locations.
- C. Control Joints: Install control joints in specific locations approved by Architect for visual effect as follows:
1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:
 - a. Vertical Surfaces: 144 sq. ft. (13.4 sq. m).
 - b. Horizontal and other Nonvertical Surfaces: 100 sq. ft. (9.3 sq. m).
 2. At distances between control joints of not greater than 18 feet (5.5 m) o.c.
 3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.



4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

6 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus **1/4 inch in 10 feet (6.4 mm in 3 m)** from a true plane in finished plaster surfaces, as measured by a **10-foot (3-m)** straightedge placed on surface.
2. Grout hollow-metal frames, bases, and similar work occurring in plastered areas, with base-coat plaster material, before lathing where necessary. Except where full grouting is indicated or required for fire-resistance rating, grout at least **6 inches (152 mm)** at each jamb anchor.
3. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
4. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Concealed Interior Plasterwork:

1. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.
3. Where plaster application will be used as a base for adhesive application of tile and similar finishes, finish coat may be omitted.

7 CUTTING AND PATCHING

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

3.8 CLEANING AND PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from doorframes, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.



PAINTING

PART 1 - GENERAL

RELATED DOCUMENTS

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

SUMMARY

- A. This Section includes surface preparation and field painting of exposed interior items and surfaces.
1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
 - B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
 - C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
 1. Prefinished items include the following factory-finished components:
 - a. Architectural woodwork.
 - b. Acoustical wall panels.
 - c. Metal toilet enclosures.
 - d. Metal lockers.
 - e. Unit kitchens.
 - f. Elevator entrance doors and frames.
 - g. Elevator equipment.
 - h. Finished mechanical and electrical equipment.
 - i. Light fixtures.
 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
 - a. Foundation spaces.
 - b. Furred areas. (Unless otherwise indicated in the schedule of finish)
 - c. Ceiling plenums. (Unless otherwise indicated in the schedule of finish)
 - d. Utility tunnels.
 - e. Pipe spaces.
 - f. Duct shafts.
 - g. Elevator shafts. (Unless otherwise indicated in the schedule of finish)
 3. Finished metal surfaces include the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.



d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Match Architect's samples.

EXECUTION

EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

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

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

PREPARATION

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

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

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

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

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

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.



- b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
- c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
- d. **Apply several layers of putty (minimum of three coats)**
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
 - 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 - 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 - 3. Provide finish coats that are compatible with primers used.
 - 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convactor covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 - 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 - 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 - 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 - 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 - 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 - 4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.



1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
 1. Uninsulated metal piping.
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
- G. Electrical items to be painted include, but are not limited to, the following:
 1. Switchgear.
 2. Panelboards.
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.



THERMAL AND MOISTURE PROTECTION

BITUMINOUS, CEMENTITIOUS, EPOXY, DAMPPROOFING AND WATERPROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

This section includes hot or cold single or multiple coats of asphalt or bitumen or paint or sheet waterproofing and damp roofing as shown on the drawings and the requirements of the contract documents including but not limited to the following:-

A. Cold applied bitumen waterproofing paint, or sheet to concrete and masonry and behind cladding, plaster and ceramic tiles to wet area walls and slabs and at junctions of masonry walls and site concrete.

B. Protective high build epoxy resin waterproof coating to floors, walls and water tanks.

C. Applied cementitious waterproofing to swimming pools.

D. Two component acrylic modified Cementitious coating to stores, plant rooms, gutters and planters where shown.

E. Below grade damp proofing.

F. Cavity wall damp proofing.

1.02 SYSTEM DESCRIPTION

A. Waterproofing System: Application of bituminous paint, sheet and coatings to prevent moisture migration.

B. Location: Where shown on drawings.

C. Internal coating to potable water tanks.

D. Protective coating to floors.

1.05 SUBMITTALS

A. Submit under provisions of Section 01330.

B. Product Data: Provide properties of proposed material.

C. Manufacturer's Installation Instructions: Including any special procedures.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.06 SUBMITTALS FOR REVIEW

A. Section 01300 - Submittals, Procedures for Submittals.

B. Product Data : Provide manufacturers data on materials performance, properties, preparation, areas of application, application, mixing, consumption.

C. Submit shop drawings for review and approval showing the location, materials, construction details including coordination with and incorporation into the overall construction.

1.07 QUALITY ASSURANCE

A. Perform work in accordance with manufacturers instructions.



- B. Test material samples in accordance with ANSI/ASTM D449 D450.
- C. Maintain one copy of each document on site.

1.08 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum five years experience.

1.09 MOCKUP

- A. Provide mockup of waterproofing systems under provisions of section 01400.
- B. Mockup may remain as part of the work.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Maintain conditions recommended by manufacturer.

1.11 WARRANTY

- A. Provide ten year warranty under provisions of Section 01700.
- B. Warranty: Include coverage for waterproofing failing to resist penetration of water.
- C. For warranty repair work, be responsible for removing and replacing materials concealing waterproofing.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Materials shall be as Tretolastic damp surface primer with 2 coats Tretol 202T bitumen solutions to wall manufactured by Tretol Bid Product Ltd. with Pluvex bitumen sheet manufactured by Ruberoid Building Products Ltd. or other equal and approved equivalent products to walls and floors of wet areas.

- B. Non-toxic solvent high build, protective epoxy resin, as Ceilcote 180 manufactured by "Feb Master Builders" or other equal and approved equivalent products to linings of potable water tanks.

- C. Two component acrylic modified cementitious coating, as Masterseal manufactured by "Feb Master Builders" or other equal and approved equivalent products to floors and skirtings.

- D. Acceptable Manufacturers for Dampproofing:

1. W.R. Grace and Company or equal and approved.
2. Celotex Corporation or equal and approved.
3. FEB Products or equal and approved.
4. Dermabit or equal and approved.

- E. Bituminous Dampproofing for Below Grade Applications (DAMP-1): Fiber reinforced (non-asbestos), solvent-base, non-sag asphaltic coating designed for troweled application and conforming to the following.

1. ASTM D-2822, Type 1.
2. Fed. Spec. SS-C-153C, Type 1, Class A and B.

- F. Bituminous Damp proofing for Cavity Wall Applications (DAMP-2): Fiber reinforced (nonasbestos), solvent-base, semi-mastic asphaltic coating designed for sprayed application and conforming to the following.



1. ASTM D-2823
2. Fed. Specs. SS-A-694D.

G. Emulsified Bituminous Damp proofing for Below Grade Applications (DAMP-3): Fiber reinforced (non-asbestos), water-base, non-sag asphaltic coating designed for troweled application on damp substrate and conforming to the following.

1. ASTM D-1227, Type 4.
2. Fed. Spec SS-R-1781, Type 1

I. Emulsified Bituminous Damp proofing for Cavity Wall Application (DAMP-4): Fiber reinforced (non-asbestos), water-base, non-sag asphaltic coating designed for spray application on damp substrate and conforming to the following.

1. ASTM D1227, Type 4.
2. Fed. Spec SS-R-1781, Type 1.

J. Polyethylene Sheeting: 0.15mm thick, fungi resistant polyethylene sheeting conforming to Voluntary Product Standard PS17-69.

K. Neoprene Flashing: 1.5mm thick, fungi resistant polyethylene sheeting conforming to Voluntary Product Standard PS17-69.

L. Protection Board: Semi-rigid 12mm by 1200 mm by 2400 mm panels with a blend of asphalt and inorganic mineral filler particles with asphalt-saturated felt and fiberglass met coating.

1. Acceptable manufacturer and product:
 - a. Celotex Corporation or equal and approved.
 - b. W.R. Meadows, Inc.: PC-2 Protection Course or equal and approved.

M. Water Tank: Flexible two part waterproofing membrane comprising of a liquid component of selected polymers and a powder component of selected cements, fillers and aggregates. Complies with:

- AS/NZS 4020:2002 Testing of Products For Use In Contact With Drinking Water - Australian Water Quality Centre Report Number 4007/92.1595
- AS4858 Class 11

Acceptable Manufacturer Cristoflex or equivalent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

B. Verify items which penetrate surfaces to receive waterproofing are securely installed.

C. Flash around all penetration.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive waterproofing.

B. Clean and prepare surface to receive waterproofing in accordance with manufacturer's instructions.



C. Do not apply waterproofing to surfaces unacceptable to manufacturer or applicator.

D. Apply mastic to seal penetrations, small cracks, or minor honeycomb in substrate.

3.03 APPLICATION

A. Install materials in accordance with the manufacturers instructions and prime surfaces in accordance with manufacturer's instructions.

B. Apply to walls in internal wet areas up to height of tiling or stone cladding.

C. Apply below external double skin masonry walls.

D. Apply to concrete and blockwork below grade.

E. Apply to all external concrete and blockwork backings to external cladding.

F. Apply to under sides of sloping concrete canopies to receive finishes.

G. Apply where shown on drawings.

H. Fill depressions, holes, and cracks with a material compatible with the dampproofing.

I. Provide bituminous dampproofing where indicated as DAMP-1 or DAMP-3 and on exterior side of below grade walls where interior floor slab is below exterior grade.

J. Expansion and Control Joints in Below Grade Walls:

1. Install joints before application of dampproofing.

2. Prime substrate which is to receive flashing adhesive as recommended by adhesive manufacturer.

3. Install continuous strip of neoprene flashing centered over joint. Roll into adhesive to ensure bond.

a. Ensure that center portion of neoprene flashing over joint (25mm from each side of joint center line) is not bonded. Do not stretch flashing over joint.

b. Trowel flashing adhesive continuously along each edge of neoprene flashing to provide watertight seal.

4. Terminate under horizontal waterproofing above.

K. Spray apply bituminous dampproofing where indicated as DAMP-2 or DAMP-4 and on exterior of interior wythe (within the cavity) of masonry cavity walls.

1. Apply dampproofing to obtain a film thickness of not less than 1.5m.

3.04 PROTECTION OF FINISHED WORK

A. Where applicable protect finished work under provisions of Section 01500.

B. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 07160



MODIFIED BITUMEN ROOFING - PROTECTED MEMBRANE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Multiple ply roofing as shown on drawings and schedules of felt and polyester mats and modified asphalt bitumen on insulation with associated membrane, ballast and pavers with all required flashings including but not limited to the following:-

1. Modified Bitumen Membrane Roofing.
2. Board Insulation.
3. Aggregate, Pavers, Ballast over Water Pervious Fabric.
4. Flashings and Accessories.

1.02 RELATED SECTIONS

- A. Section 07212 - Board Insulation.
- B. Section 07620 - Sheet Metal Flashings & Trim
- C. Section 07820 - Skylights
- D. Section 15430 - Plumbing Specialties: Drains. Hoppers.
- E. Section Division 15 Mechanical: Prefabricated curb for mechanical equipment.

1.03 REFERENCES

- A. ASTM E84 - Surface Burning Characteristics.
- B. ASTM E119 - Fire Resistance Ratings.
- C. ASTM E136 - Combustion Characteristics.
- D. ASTM C177 - Test Method for Steady-State Thermal Transmission Properties by Means of the Guarded Hot Plate.
- E. ASTM D41 - Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- F. ASTM D312 - Asphalt Used in Roofing.
- G. ASTM D2178 - Waterproofing.
Asphalt Impregnated Glass (Felt) Mat Used in Roofing and
- H. FM - Roof Assembly Classifications.
- I. NRCA (National Roofing Contractors Association) - Roofing and Waterproofing Manual.
- J. ULI - Fire Hazard Classifications.

1.04 SYSTEM DESCRIPTION

A. Modified Bitumen Protected Membrane Roofing System: Single ply torch applied membrane system with loose laid insulation covered by filter membrane, and gravel ballast or paver finish.



1.05 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Shop Drawings: Indicate setting plan for insulation and membrane(s), layout of seams, direction of laps, base flashing details and expansion joints.
- C. Product Data: Provide information for membrane and bitumen materials, base flashing materials, insulation and pavers.
- D. Samples: Submit two samples 2.2 Kg containers of roofing aggregate. Two 300mm lengths of membrane and two pavers.
- E. Manufacturer's Installation Instructions: Indicate special precautions required for seaming the membrane.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Submit under provisions of Section 01400.
- H. Reports: Indicate procedures followed, ambient temperatures and wind velocity during application.
- I. Manufacturers 10 years warranty for materials being submitted for approval will be included with the submittal.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with manufacturer's instructions.
- B. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with five years documented experience.
- B. Applicator: Company specializing in performing the work of this section with five years documented experience and approved by system manufacturer.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable code for roof assembly fire hazard requirements.
- B. ULI: Class A Fire Hazard Classification.
- C. FM: Roof Assembly Classification, of Class 1 Construction, in accordance with FM Construction Bulletin 1-28.
- D. UL Listing: Provide labeled materials which have been tested and listed by UL in "Building Materials Directory" for application indicated, with "Class A" rated materials/system for roof slopes shown.
- E. Fire Performance Characteristics: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.

1.09 MOCKUP

- A. Provide mockup of each roof membrane system and associated components and accessories under provisions of Section 01400.
- B. Mockup Size: 3 x 3 m, including insulation, water pervious fabric, ballast, and typical base and counter flashings specified at location designated.
- C. Mockup may not remain as part of the Work.

1.10 PRE-INSTALLATION CONFERENCE

- A. Convene one week prior to commencing work of this section, under provisions of Section 01039.
- B. Review installation procedures and coordination required with related Work.



1.11 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Section 01600.
- B. Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.
- C. Store products in weather protected environment, clear of ground and moisture.
- D. Stand roll materials on end.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply roofing membrane during inclement weather ambient temperatures below 15 degrees C.
- B. Do not apply roofing membrane to damp or dirty deck surface.
- C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.13 COORDINATION

- A. Coordinate work under provisions of Section 01039.
- B. Coordinate the work with installing associated metal flashings as the work of this section proceeds.

1.14 WARRANTY

- A. Provide 10 years warranty under provisions of Section 01700.
- B. Warranty: Cover damage to building resulting from failure to prevent penetration of water and exposing defects and making good to all damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS - MEMBRANE MATERIALS

- A. Refer to appendix "A".
- B. Substitutions: Under provisions of Section 01630.

2.02 SINGLE LAYER COVERED SYSTEM

- A. Membrane: APP modified Bitumen Membrane reinforced with 200 gm/m² polyester mat nominal. Thickness: 4 mm. primer to ASTM D-41.
- B. Separation layer: 150 microns polyethylene sheet.
- C. Insulation Boards: Extruded polystyrene rigid foam 50mm thick. As "Roofmate" manufactured by Dow Corning or equal and approved, having the following properties:
 - 1. Five year aged average thermal conductivity of 0.032 w/mk when tested at 24 C in accordance to ASTM C-518.
 - 2. Compressive strength of 280 kPa average, when tested according to ASTM D-1621.
 - 3. Water absorption of 1% in volume average when tested in accordance with ASTM D-2842.
 - 4. Water vapour permeability of 0.6 perm inch average when tested in accordance with ASTM C-355.
- D. Filter Layer: 150 microns polyethylene fabric.
- E. Finish Layer: 40 mm precast cement concrete pavers or ceramic tiles on screed bed as shown.
- F. Flashing: Paver skirting minimum 150 mm high above finished slab or floor level to protect membrane upstand.
- G. Sealant: Silicone solar resistant building sealant
ASTM C920, Grade 50, Use + NT M GAO and GSA
 - 1. Elongation capability +100 - 50 %
 - 2. Service temperature range -up to 149°C.

2.03 SINGLE LAYER PROTECTED SYSTEM

- A. Membrane: APP modified Bitumen Membrane reinforced with 200 gm/m² polyester mat nominal. Thickness: 4 mm. primer to ASTM D-41.
- B. Separation layer: 150 microns polyethylene sheet.



C. Insulation Boards: Extruded polystyrene rigid foam 50mm thick. As "Roofmate" manufactured by Dow Corning or equal approved, having the following properties:

o 1. Five year aged average thermal conductivity of 0.032 w/mk when tested at 24 C in accordance to ASTM C-518.

2. Compressive strength of 280 kPa average, when tested according to ASTM D-1621.

3. Water absorption of 1% in volume average when tested in accordance with ASTM D-2842.

4. Water vapour permeability of 0.6 perm inch average when tested in accordance with ASTM C-355.

D. Filter Layer: 150 microns polyethylene fabric.

E. Gravel Ballast: Washed Wadi bed gravel 10-18 mm diameter minimum 50 mm overall thickness.

F. Walkways: 400x400x40 mm concrete panels loose laid on plastic spacers.

G. Flashing: Solar reflective granule finish on membrane (as 2.03 A. above) minimum 150 mm high held in place with extruded aluminum pressure plate and solar resistant sealant seal.

H. Sealant: Silicone solar resistant building sealant ASTM C920, Grade 50, use + NT M G A O and GSA,

1. Elongation capability +100 - 50%

2. Service temperature range -54 to 149°C

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secured.

C. Verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains, valleys, or eaves.

D. Confirm dry deck by moisture meter with 12 percent moisture maximum.

E. Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and cant strips wood nailing strips and reglets are in place.

F. Verify roof drain is set to achieve weep drainage at membrane level and top grating of drain at finish deck level.

3.02 PREPARATION - CONCRETE DECK

A. Fill surface honeycomb and variations with cementitious filler.

3.03 PREPARATION STEEL DECKS

A. Comply with manufacturer's instructions, except where more stringent requirements are indicated.

B. Vapor Retarder Installation:

1. On steel decks, comply with UL requirements for "Roof Deck Constructions" which are rated "Fire Acceptable" or comply with FM requirements for "Class I" metal deck construction.

2. Seal joints in vapor retarder and seal to other surfaces at extremities and penetrations of retarder. Seal over nails, staples, tears, and punctures with tape or adhesively applied strips of vapor retarder material.

3. Do not apply hot bitumen under conditions which result in foaming of material.

3.04 MEMBRANE APPLICATION

A. Apply membrane and primer in accordance with manufacturer's instructions.

B. Lay one ply base sheet, coated side down. Lap sides and ends in accordance with membrane manufacturer's instructions.



- C. Equiviscous Temperature at Point of Application: Within 14 C degrees of bitumen rating labelled on bitumen container.
- D. Apply membrane; seal seams and ends permanently waterproof.
- E. Apply membrane smooth, free from air pockets, wrinkles, or tears.
- F. Extend membrane up cant strips and minimum of 200 mm onto vertical surfaces above finished roof level.
- G. Install waterproof cut-off to membrane at end of day's operation. Remove cut-off before resuming roofing.
- H. Mop and seal membrane around roof penetrations and protrusions.

3.05 FLASHINGS AND ACCESSORIES

- A. Apply flexible sheet base flashings to seal membrane to vertical elements.
- B. Install prefabricated roofing control expansion joints in accordance with manufacturer's instructions.
- C. Coordinate installation of roof drains, sumps, curbs, and related flashings.
- D. Seal flashings and flanges of items penetrating or protruding through the membrane.

3.06 BALLAST INSTALLATION

- A. Apply aggregate ballast, applied dry and at the rate of 4 900 kg/100 sq m.
- B. Evenly distribute aggregate cover.
- C. Install precast cement concrete pavers provided under Section 02518.
- D. Install pavers directly on insulation on plastic spacers. Provide approximately 6 mm space between pavers to permit surface water drainage.

3.07 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01410.
- B. Correct identified defects or irregularities.
- C. Require site attendance of roofing and insulation materials manufacturers during installation of the Work.
- D. On completion of the roof water proofing installation including the insulation and ballast, dam roof area and flood to a minimum depth of 75mm for at least 24 hours. If any leak appears during that period, remove dam materials, ballast and insulation and repair the waterproofing membrane as necessary. Replace insulation and ballast and retest the roof as specified above. This procedure shall be repeated until the roof proves to be watertight under test.

3.08 CLEANING

- A. Remove bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.
- C. Repair or replace defaced or disfigured finishes caused by work of this section.

3.09 PROTECTION

- A. Protect building surfaces against damage from roofing work.
- B. Where traffic must continue over finished roof membrane, protect surfaces.

END OF SECTION 07555