KARACHI NEIGHBORHOOD IMPROVEMENT PROJECT (KNIP)

REHABILITATION AND UPGRADATION OF BOAT BASIN TO SCHON CHOWRANGI WITH PEDESTRIAN TRAIL AND GIZRI SPORTS GROUND

BIDDING DOCUMENT
VOL-II
TECHNICAL SPECIFICATIONS FOR PUBLIC HEALTH WORKS
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SECTION - 1

EXCAVATION, TRENCHING AND BACKFILLING

1.1 SCOPE

The work covered by this section of the Technical Specifications consists of furnishing all plant, labour, equipment, appliances, and the materials for performing all operations in connection with excavation, trenching and back-filling for water supply, sewerage and structures including all incidental works necessary for excavation to the required depth and dimensions in accordance with the applicable drawings, or as directed by the Engineer. The work shall be carried out in complete conformity with the specifications, setforth hereunder.

1.2 SETTING OUT

The Contractor shall set out the works in accordance with the dimensions, lines and levels shown on the Drawings. Where no precise positions or levels are shown on the drawings, the works shall be set out by the Contractor to the positions and levels determined by the Engineer's Representative as the work proceeds.

1.3 CLEARING AND GRUBBING

The sites of all excavations shall be cleared of all shrubs, plants, bushes, large roots, rubbish and other objectionable materials. All such materials shall be removed from site of work or otherwise disposed of at no extra cost in a manner satisfactory to the Engineer. All trees and shrubs that are designated by the Engineer to remain shall be adequately protected and preserved in an approved manner.

1.4 EXCAVATION

1.4.1 General

All excavation of whatever substance encountered shall be performed to the depths indicated or as otherwise specified. During excavation, material suitable for back-filling shall be stockpiled in an orderly manner at a sufficient distance from the banks of the excavation to avoid overloading and to prevent sides from caving. All excavated material unsuitable for backfill shall be removed and placed at a location approved by the Engineer. Grading shall be done as may be necessary to prevent surface water from flowing into the trenches or other excavations, and any water accumulated therein shall be removed by pumping or by other approved methods. Unless otherwise indicated or approved by the Engineer, excavation shall be open cut. For Contract purposes hereunder the

earth excavation work has been classified into two categories, earth excavation in trenches and earth excavation for structures.

1.4.2 Earth Excavation in Trenches

Unless otherwise directed or permitted by the Engineer not more than 100 ft of any trench in advance of the end of the pipeline already laid shall be opened at any time. Trenches shall be excavated to the dimensions and depths shown on the drawings or ordered by the Engineer or in such a position or to such dimensions and depths as shall allow for the proper construction of the relevant structure or proper excavation of the relevant operation. Pipe trenches shall be excavated to give a clear width of 6 inches on either side of the pipe. Additional excavation shall be carried out to give ample space for making joints and, where necessary, for concrete bedding or surround.

The banks of the pipe trench shall be as nearly vertical as practicable. Bell holes and depressions for joints shall be dug after the trench bottom has been prepared. The pipe, except for joints, shall rest on the prepared bottom for its full length. Bell holes and depressions shall be only of such length, depth, and width as required for properly making the particular type of joints. Stones shall be removed to avoid point bearing. Whenever wet or otherwise unstable material that is incapable of properly supporting the pipe as determined by the Engineer is encountered in the bottom of the trench, such material shall be removed to the depth required and the trench backfilled to the proper grade with coarse sand, or other suitable approved granular material. Such replacement of unsuitable material will be paid for at the contract unit price for that item of work as shall be agreed upon, before execution of this work, with the Engineer.

Where the Contractor has excavated to depths in excess of the requirements, from his neglect or from causes within his control, he shall refill and compact the excess excavation with suitable material approved by the Engineer, upto corrected level, at his own expense.

Excavation of appurtenances shall be sufficient to leave at least 12 inches but not more than 24 inches between the outer surface and the embankment or timber that may be used to hold and protect the banks. Any over-depth excavation below such appurtenances that has not been directed by the Engineer, will be considered un-authorized and shall be refilled with compacted sand, gravel or concrete, as directed by the Engineer and at no additional cost to the Employer.

1.4.3 Earth Excavation for Structures

All earth excavation under this contract, which is not included under the classification of "Earth excavation in Trenches" shall be classified and paid for as earth excavation for structures.

The Contractor shall provide adequate timbering or shoring for excavations,

should the sides and ends of any excavations give way the Contractor shall, at no extra cost, remove all disturbed ground. Any excavation carried outside the limits shown on drawings and specified herein as the payment limits, shall not be treated as excavated and shall not be paid for.

When foundation level or base of excavation is reached, the Engineer's representative will inspect the exposed ground and give directions as to what further excavation, if any, he considers necessary. The excavation should be done in such a manner, as to ensure that the work rests on a solid and perfectly clean foundation. If the Contractor allows any portion of such foundations to deteriorate due to exposure, he shall make good the foundation to the satisfaction of the Engineer without extra cost.

1.4.4 Replaced Soil under Foundations

1.4.4.1 Material

Selected well graded granular material shall be used for filling beneath the structural foundations. This material should meet the requirements of A-2-4 & A-3 (AASHTO soil classification).

The suitability of the material shall be supported by adequate tests in the laboratory.

1.4.4.2 Equipment and Procedure

Suitable equipment shall be selected by the Contractor on the basis of field trials for compaction. The contractor shall indicate his planning to carry out compaction in his Method Statement for Engineer's approval before undertaking actual compaction. A test section would be required to select the most suitable equipment, layer thickness, moisture content, No. of passes etc.

1.4.4.3 Compaction Standard

The contractor shall place the material to be compacted in layers. Each layer shall be of specified thickness and shall be compacted by the optimum number of passes as explained in above section. Compaction less than 75% of relative density or 95% of Modified Proctor Density shall not be acceptable.

1.4.4.4 Quality Control

Every compacted layer shall be tested for quality of compaction by performing in-situ density tests. Sand replacement method of density measurement shall be used. The evaluation of 75% relative density or 95% Modified Proctor Density shall be based on measurement of maximum, minimum and maximum Modified Proctor Densities in the laboratory. The frequency of this testing shall be instructed by the Engineer at the site.

1.5 PRECAUTIONARY AND REMEDIAL MEASURES

1.5.1 Protection of Existing Facilities and Structures

The Contractor shall take every necessary precaution not to endanger the safety, occupation or operation of any property, structures, installations or services in the vicinity of his operations and shall observe any restrictions imposed by the Authority concerned and the Engineer to this end. Should any such property, structures, installations or services be endangered or damaged as a result of the Contractor's operations, he shall immediately report any such danger or damage to the Engineer's Representative and any Authority concerned and shall forthwith undertake remedial measures to the satisfaction of the Engineer and the appropriate Authority with out additional cost.

1.5.2 Planking and Strutting

The Contractor shall provide at his own expense to the satisfaction of the Engineer all timbering, poling, shoring, strutting and other approved supports to the sides of all excavations, trenches and all other works in such a way as will be sufficient to secure them from falling and to prevent any movement. All responsibilities connected with this part of the work shall rest with the Contractor.

In removing timbering, shoring and strutting and all other supports from excavation and trenches, special care shall be taken to avoid pressure on fresh concrete or any other work until it is sufficiently safe to resist such pressure.

1.5.3 Dewatering

The Contractor shall build all drains and do ditching, pumping, well pointing, bailing, and all other work necessary to keep the excavation clear of ground water, sewage and storm water during the progress of the work and until the finished work is safe from injury. All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Engineer and necessary precautions against flooding shall be taken. The procedure for dewatering of subsoil water from excavation for the purpose of construction of sewer lines and other structures shall be in accordance with the method given below:

- Dewatering of subsoil water from excavations of trenches and excavations for other structures shall be arranged by an adequate process of well-pointing, bailing and/or pumping or by any other suitable method approved by the Engineer on the basis of the method (statement to be submitted by the Contractor).

- If well-points are used then the following requirements shall be met with. Well-pointing shall consist of bore holes, provided with necessary strainers, blind pipes and pumping machinery, and these shall be of suitable size and depth and shall be located on both sides of the trench

and along the periphery of water level to a sufficient depth to keep the excavations clear of subsoil water during the process of construction.

- As a part of the work and at no extra cost, the Contractor shall provide all strainer pipes and other requisite material, and boring tools and plant, etc. for the well pointing and shall also provide pumping equipment as well as operating personnel, power, etc. Dewatering of subsoil water shall be continuous process round the clock during the progress of the work and until the finished work is safe, from injury to the complete satisfaction of the Engineer's representative and any interruption in continuous pumping and causing injury to the works done or under construction shall require the Contractor to repair or rebuild the works to the entire satisfaction of the Engineer's representative at no extra cost. No extra payment shall be made to the Contractor for the disposal of storm water and for dewatering in trenches and building structures less then 5 ft. depth.

1.5.4 Maintenance of Excavation

All excavation shall be properly maintained while open and exposed. Sufficient suitable barricades, warning lights, flood lights, reflective signs, and similar items shall be provided by the Contractor. The Contractor shall be responsible for any damage due to his negligence.

1.5.5 Surplus Materials

All surplus materials shall be disposed of at locations approved by the Engineer. The disposal of surplus material shall not interfere with other works and shall not damage or spoil other material. When it is necessary to haul earth or rock material over street or pavement, the Contractor shall prevent such material from falling on the street or pavement.

1.5.6 Cutting Pavement

In cutting or breaking street surfacing, the Contractor shall not use equipment which will damage the adjacent pavement. Existing paved surfaces shall be cut back beyond the edge of trenches to form neat square cuts. The road ballast, brick pavement, and other materials shall be placed on one side and shall be preserved for reinstatement when the trench is filled. Wherever necessary or required for the convenience of the public or individual residents, at street crossings and at private driveways, the Contractor shall provide suitable temporary bridges which shall be maintained in service until backfilling has been completed. The Contractor shall keep the road crossings manned 24 hours per day. During night time, enough red lights shall be provided to warn the traffic. If detour is necessary, the Contractor shall make proper detour for the traffic and shall install signs 3 ft. x 4 ft. in size indicating the detour.

1.6 TRANSPORTATION OF MATERIAL

All carts, trucks or other vehicles used by the Contractor for transportation of the material shall be suitably constructed or lined not to permit any leakage/spillage of soil while the vehicles are on the move. These would be so loaded and arranged as not to spill on the site and public roads. Whenever any vehicle so used is found leaking/spilling and unsuitable, it shall be immediately withdrawn from the work on notification by the Engineer.

1.7 COMPACTED FILL AND BACKFILL

1.7.1 General

After the completion of water and sewer lines, foundations, walls and other structures below the elevation of the final grade, all voids shall be backfilled with suitable materials, as specified below.

1.7.2 Backfilling for Structures

Backfilling operations for structures shall be performed as part of the Contractor's work under the payment items for earth excavation and at no extra cost to the Owner. It would comprise returning and filling the selected excavated material around foundations, and at back of walls etc., upto finished levels shown on the Drawings or as required in layers not exceeding 6 inches, carefully rammed and consolidated (with addition of water if required) so as to achieve a minimum relative density of 90% of modified proctor test at optimum moisture content. No fill shall be made until the concrete foundations and footings etc., have been inspected and approved by the Engineer. Earth to be used for filling must be free of all the organic impurities, debris or any other foreign matter. Earth which contains more than 1% of salts particularly sulphates will not be used in filling.

1.7.3 Backfilling of Trenches

The trenches shall not be completely backfilled until all required pressure tests are performed and until the water lines as installed conform to the requirements of specifications. Where in the opinion of the Engineer, damage is likely to result from withdrawing sheeting, shoring, the same shall be left in place and cut off at a level 1 ft. below ground surface. Sheeting left in place shall be paid for at the approved rate for that item of work. Trenches shall be backfilled to the ground surface with selected excavated material or other material that is suitable for proper compaction. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted to the specified density. The surface shall be restored to its original or better condition. Pavement and base course disturbed by trenching operations shall be replaced.

1.7.4 Lower Portion of Trench

Backfill material below and around pipe shall be deposited in 6 inch maximum thickness layers and compacted with suitable hand tampers to 90% of maximum density until there is a cover of not less than 1 ft. over the pipe. The backfill material in this portion of trench shall consist of sandy clay or other approved materials free from stones and lumps.

1.7.5 Remainder of Trench

The remainder of the trench portion above pipe shall be backfilled with material that is free from stones larger than 6 inch in any dimension. Backfill material shall be compacted to achieve a minimum relative density of 90% of modified proctor test at optimum moisture content for cohesive soils and 95 percent of maximum density for others.

1.8 BORROW

In case of insufficiency of excavated material and un-suitability of earth for backfilling, conforming to the above specifications, such material shall be brought from the source approved by the Engineer.

1.9 GRADING

After the completion of all backfilling operations, the Contractor shall grade the work areas to the lines, grades and elevations shown on the drawings or as directed by the Engineer. Finished grading shall not be done until the installation of all utilities or appurtenance. All damage due to settlement shall be repaired by and at the expense of the Contractor.

1.10 TESTING OF SOIL IN PLACE

The Engineer will make tests using the calibrated cone method/core cutter method to determine the density of soil in place. If soil in place fails to meet the specified degree of compaction the areas represented by the failing tests shall be removed, replaced and compacted to the specified density in the manner directed by the Engineer and at no additional cost to the Owner.

1.11 MEASUREMENT AND PAYMENT

1.11.1 Excavation and Backfilling

1.11.1.1 Method of Measurement

The measurement shall be made in cubic feet of earth acceptably excavated and backfilled for trenches and structures within the lines and grades shown on the drawing or as directed by the Engineer.

1.11.1.2 Basis of Payment

Payment for earth excavation and backfilling in trenches or structures will be made at the contract unit price per cubic ft.

The cost of dewatering, disposal of earth & earth & any shuttering or support required for excavation is included in the execution unit price.

Description	Unit
Excavation for structures and compacted backfill including dewatering & disposal of surplus material.	Cft.
Excavation for trenches and compacted backfill including dewatering & disposal of surplus material.	Cft.

SECTION - 2

CONCRETE

2.1 SCOPE

This section covers the manufacture, forming, transporting, placing, stripping of forms, finishing and curing of plain and reinforced normal concrete in the structures included herein.

2.2 SPECIFICATIONS

Concrete work shall conform to all requirements of ACI 301-72, (Revised 1975), Specifications for Structural Concrete for Buildings, except as modified by supplemental requirements below. The Contractor shall submit, for the approval of the Engineer, before commencement of any work, his Method Statement which would provide complete details of the procedures and equipment to be used for the satisfactory execution of the work. The approval of such Method Statement shall not relieve the Contractor of any of his responsibilities under the Contract.

2.3 COMPOSITION AND QUALITY

Concrete shall be composed of Portland cement, water, fine and coarse aggregates and any admixtures as and when specified. The concrete mixes will be designed by the Engineer who will determine the required quality of the concrete for the structures covered by these Specifications. The desired strength of concrete for various parts of the structures have been shown on the Drawings. Such concrete mixes shall not relieve the Contractor of the responsibilities to the achieve the desired strength of concrete for various parts of structures as specified in the Technical Specifications or shown on the Drawing and to the full satisfaction of Engineer.

2.4 CEMENT

2.4.1 General

Cement shall be furnished in sacks or in bulk form as approved by the Engineer. Unless otherwise permitted, cement from not more than two plants shall be used and in general, the product from only one plant shall be used in any particular section of the work. No cement recovered through cleaning sacks shall be used.

2.4.2 Portland Cement

Portland cement shall be indigenous stuff unless otherwise approved by the Engineer. Portland cement shall conform to latest British Standard 12:1971, Specifications for Portland Cement or to ASTM Designation C150- 74, Standard Specifications for Portland Cement for Type I. Portland cement conforming to ASTM Designation C150-74, Type II or IV may also be used in certain parts of work as directed by the Engineer.

2.4.3 Tests

Cement shall be sampled at storage site and tested from time to time at the discretion of the Engineer in accordance with the ASTM Designation C150-74 or its equivalent British Standards. Expenses for such tests shall be borne by the Contractor. If the tests prove that the cement has become unsatisfactory, it shall be discarded and thrown as rejection as directed and to the full satisfaction of the Engineer. Cement which has been in storage at the project site longer than four months, shall not be used until retesting proves it to be satisfactory.

2.4.4 Storage

Cement shall be stored in dry, weather tight and properly ventilated structure. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification of each consignment. Sufficient cement from a single source shall be in storage at the work site to complete any lift of concrete stored. Adequate storage capacity shall be furnished to provide sufficient cement to meet the peak needs of the project. Cement in sacks shall be stored on a damp proof floor and shall not be piled to a height exceeding 6 feet.

The Contractor shall use cement in the approximate chronological order in which it is received at the site. All empty sacks shall be promptly disposed of as permitted and directed by the Engineer so as to avoid any confusion in use of quantity of cement.

Cement storage facilities shall be emptied and cleaned by the Contractor when so directed, however the interval between required cleaning normally will not be less than four months.

Suitable, accurate scale shall be provided by the Contractor for weighing the cement in stores and elsewhere on the work, if required, and he shall also furnish all necessary test weights.

2.4.5 Delivery and Usage Record

Accurate records of receipts of cement at site and its use in the work shall be kept by the Contractor. Copies of these records shall be supplied to the Engineer in such a form as he may require.

2.5 AGGREGATES

Materials used as aggregates shall be obtained from sources known e.g Margalla/Shaheenabad to produce satisfactory results for the different classes of concrete. The use of aggregates from sources which have not been approved by the Engineer shall not be permitted.

2.5.1 Fine Aggregate for Concrete

Fine aggregate for all the classes of concrete shall be well graded natural sand, stone screenings or other inert material of similar characteristics or a combination of these. The whole of it shall be perfectly clean, free from coagulated lumps, soft and flaky particles, shale alkali, organic matter, loam mica and injurious amount of other deleterious substances. Maximum allowable content of silt and other deleterious inert substances is 5 percent by washing. Material derived from stone unsuitable for coarse aggregate shall not be used as fine aggregate. Fine aggregate derived from stone screenings shall be sharp, cubical, hard, dense and durable and shall be stacked on a platform so as to adequately protect it from dust and other admixtures.

Grading for the above specified fine aggregate shall be within the following limits, as determined by the Owner:

Sieve Size	**Percentage Passing (Dry Weight)**
3/8 inches	100
No. 4	95 to 100
No. 8	80 to 90
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

Fine aggregate for class D (1000 psi) concrete may be good quality bank run sand obtained from the River in vicinity. It shall be clean natural material graded from fine to coarse, free from lumps, clay, cinder, ashes, rubbish and other debris. It shall not contain more than 5 percent of material finer than No. 200 mesh screen, not more than 5 percent remaining on No. 4 sieve; all material shall pass through 3/8" screen.

2.5.2 Coarse Aggregate for Concrete

Coarse aggregate for the first 3 classes of concrete shall consist of quarried or crushed stone/river run gravel or inert material or a combination of these, with maximum size of 3/4 inch and shall be clean, hard durable, sound, cubical and well shaped, free from soft or friable matter, or thin elongated pieces, alkali, organic matter or injurious amounts of other deleterious substances. Deleterious inert matter shall not exceed 3 percent.

Grading for above specified coarse aggregate shall be within the following limits:

Sieve Size	**Percentage Passing (Dry Weight)**
1 inch	100
3/4inch	90 to 100
1/2 inch	20 to 55
3/8 inch	0 to 10
#-4	0 to 5

Coarse aggregates for Class D (1000 psi) concrete shall be broken stone or river run gravel from dense hard stone, or boulders. The stone or gravel should not be porous or slaty it must be free from earth, sand or other foreign matters. The broken aggregate or gravel shall be of the prescribed size for the class D (1000 psi). The broken aggregate or gravel shall be of max. size 1 inch or 1 1/2 inches and not contain any thing which will pass through No.4 sieve.

2.5.3 Storage of Aggregate

Each class of aggregate is to be stored separately and the Contractor is to provide means of ensuring that aggregates are stored on a suitable hard clean surface or platform to prevent contamination from the ground.

2.5.4 Proportions of Coarse and Fine Aggregates

The nominal ratio of the Volume of coarse aggregate to the volume of fine aggregate shall be decided by compression test of concrete cubes or cylinders to be furnished by the Contractor but the Owner may order these ratios to be varied slightly according to the grading of the aggregates by weight, if necessary, so as to produce required grading. Engineer can get the tests carried out at Contractor's cost.

At the beginning of the work and where there is any change in the coarse or fine aggregates or in their source of supply, the Contractor is to have a series of tests on cubes/cylinders made representative of and marked as to the aggregates and their grading and mix of concrete. Such cubes are to be tested in the laboratory under identical conditions, except for small variations in the relative proportions of the coarse and fine aggregates up and down from the best

proportions derived from the sieve analysis. The cubes etc. are to be tested at 7 days.

2.5.5 Water

Water for washing aggregates and for mixing and curing concrete shall be clean and free from injurious amounts of oil, acid, alkali, salt, organic matter, or other deleterious substances as determined by standard tests selected by the Engineer. It shall meet the following chemical requirements:

Chlorides such as sodium chloride	Max 3000ppm
Sulphates such as sodium sulphate	Max 2000ppm
Impurities	Max 2000ppm
Metled Salt	Max 25000ppm

The water for curing concrete should not have pH value lower than 5 and shall not contain impurities which cause discoloration of concrete.

2.6 CONCRETE MIX REQUIREMENTS

2.6.1 Strength

The concrete shall be one of four different classes to be paid for at their respective unit prices designated. The numerical classifications refer to the approximate proportions of cement, fine aggregate and coarse aggregate, according to the common practice. However, the actual concrete mix requirement shall consist of proportioning and mixing for the following strengths when tested in the form 6" cubes, 3 for 7 days and 3 for 28 days test shall be made for each class of concrete. The cubes are to be made, cured, stored, transported and tests are to be carried out at a testing laboratory approved by the Engineer. All such tests shall be at the cost of the Contractor.

Concrete Class	Cylinder (Min) Compressive Strength		Cube (Min) Compressive Strength	Tentative Ratio
	Tested at 7 days	Tested at 28 days	Tested at 28 days	
A:	2000 psi	3000 psi	4000 psi	1:1-1/2:3
B:	1600 psi	2400 psi	3000 psi	1:2:4
C:	1000 psi	1600 psi	2000 psi	1:3:6
D:	No strength requirements	800 psi	1000 psi	1:4:8

2.7 WATER CEMENT RATIO

The water-cement ratio is the ratio of the weight of water in the mix to the weight of cement therein. Water content shall be sufficient to produce a workable mix of the specified strength but the total water content shall be governed by the following table:

Concrete Class	Maximum Permissible Total Water Demand (Imperial) Gallons per 112 pounds of cement
A:	6.0
B:	7.5
C:	8.0
D:	No requirements

2.7.1 Consistency

Proportions of ingredients shall vary to achieve the desired concrete consistencies when tested, conforming to the following slump requirements or as desired by the Engineer:

Use of Concrete	Minimum and Maximum Slump (inch)
Normally reinforced sections compacted by vibration, hand compacted mass concrete.	1 to 3
Heavily reinforced concrete sections compacted by vibration, hand compacted concrete in normally reinforced slabs, beams, columns and walls.	2 to 4

In all cases, the proportions of aggregates for concrete shall be such as to produce mixes which will work readily into the corners and angles of the forms and around the reinforcement without permitting the segregation of materials or liateance. Uniformity in concrete consisting from batch to batch shall be ensured.

2.8 MEASUREMENT OF MATERIALS

The coarse and fine aggregate are to be weighed or accurately measured to the Engineer's satisfaction. In no event they are to be measured by the shovel or barrow.

2.9 MIXING METHODS

The concrete shall be mixed in an approved mechanically operated batch mixer. The mixer, its hopper and working platforms shall be protected from rain and wind.

The aggregates and cement shall be mixed together before adding water until the concrete is of even colour and consistency throughout. Dirt and other undesirable substances shall be excluded. Water shall not be added indiscriminately from a hose or can. All concrete shall be thoroughly mixed by a modern reliable batch mixer to produce maximum output of concrete necessary to complete the work within the specified time without reducing the required mixing time. Concrete shall be mixed in the concrete mixers for the duration required for uniform distribution of the ingredients to produce a homogeneous mass of consistent colour but for not less than 1 1/2 minutes. The mixer shall be operated by trained operators, who have previous experience of running and operation of concrete mixers.

At the conclusion of mixing, the mixer and all handling plants shall be thoroughly cleaned out before the concrete remaining in them has had time to set.

No concrete shall be mixed by hand without the Engineer's written consent, and such consent shall be given only for small quantities under special circumstances.

2.10 TEST OF CONCRETE

2.10.1 Strength Test During the Work

Strength tests of the concrete placed during the course of the work will be made by the Engineer in an approved laboratory at the Contractor's expenses. The Contractor shall assist the Engineer in obtaining, for control purposes, such number of cylinders or cubes as the Engineer may direct, but in general, three beams taken from each 2650 cu.ft.or fraction thereof, or from each days pour, whichever is less, of each class of concrete placed, shall govern. Test specimen will be made and cured by the Engineer in accordance with the applicable requirement of ASTM Designation C31-69, Standard Method of Making and Curing Concrete Compressive and Flexural Test Specimens in the Field.

Cubes and beams will be tested by the Engineer in accordance with the applicable requirements of ASTM Designation C39-72, Standard Method of Test for Compressive Strength of Cubical Concrete Specimens and ASTM

Designation C78-64, Standard Method of Test for Flexural Strength of concrete (Using Simple Beam with Third Point Loading). The test result will be based on the average of the strength of the test specimens except that if one specimen in a set of three shows manifest evidence of improper sampling, moulding, or testing, the test result will be based on the average of the remaining two specimens. If two specimens out of a set of three show such defects, the results of the set will be discarded and average strength determined from test results of the other two sets. The standard age of test will be 28 days, but 7 day tests may be used at the discretion of the Engineer, based on the relation between the 7 days and 28 days strengths of the concrete as established by tests for the materials and proportions used. If the average of the strength test of three specimen cured under laboratory controls, for any portion of the work, falls below the minimum allowable compressive or flexural strength at 28 days required for the class of concrete used in that portion, the Engineer may change the proportions of the constituents of the concrete, as necessary to secure the required strength for the remaining portions of the work. If the average strength of the specimens cured under actual field conditions as specified herein before falls below the minimum allowable strength, the Engineer will make such changes in the conditions for temperature and moisture under which the concrete work is being placed and cured as may be necessary to secure the required strength.

2.11 CONVEYING OF CONCRETE

Concrete shall be conveyed from mixer to the place of final deposit as rapidly as practicable, by methods which will prevent segregation or loss of ingredients and in accordance with latest edition of ACI Code Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

Any wet batch hopper through which the concrete passes shall be conical in shape. There shall be no vertical drop greater than 5 ft. except where suitable equipment is provided to prevent segregation and where specifically authorized. Belt conveyers, chutes, or other similar equipment will not be permitted either for conveying concrete except where the use of such equipment is approved in writing by the Engineer, in advance of any use. Each type or class of concrete shall be visually identified by placing a coloured tag or marker on the bucket as it leaves the mixing plant so that the concrete may be positively identified and placed in the structure forms in the desired position.

2.12 PLACING

2.12.1 General

Concrete placing shall follow the Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete, latest ACI Code requirement. No concrete shall be placed until all formwork, reinforcement, installation of parts to be embedded, bracing of forms and preparation of surface involved in the placing and the method of placement have been approved by the Engineer. Approval of the method of placement proposed will not relieve the Contractor of his

responsibility for its adequacy and he shall remain solely responsible for the satisfactory construction of all work under the Contract.

Before concrete is placed, all surfaces upon or against which concrete is to be placed shall be free from standing water, mud, debris or loose material. All surfaces of form and embedded material that have become encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed. The surfaces of absorptive material against or upon which concrete is to be placed shall be moistened thoroughly so that the moisture will not be drawn from the freshly placed concrete. Concrete shall be worked into the corners and angles of the forms and around all reinforcement and embedded items without permitting the materials to its final position in the forms. The depositing of concrete shall be regulated so that the concrete may be effectively compacted with a minimum of lateral movement into horizontal layers approximately 1.5 ft. in thickness. No concrete that has partially been hardened or contaminated by foreign materials shall be deposited in the structure, nor shall retampered concrete be used unless approved by the Engineer. The surfaces of construction joints shall be kept continuously wet for at least eighteen hours during the twenty four hours period prior to placing concrete except as otherwise directed by the Engineer. All free water shall be removed and the construction joint shall be completely surface dry prior to approval All concrete placing equipment and methods shall be subject to approval. Concrete placement will not be permitted, when in the opinion of the Engineer weather conditions prevent proper placement and consolidation.

2.13 COMPACTING CONCRETE

All concrete, except that in blinding layers and in- situ-concrete in very small sections, shall be compacted by vibration. After any necessary hand spading, working and ramming into place, each layer of concrete shall be compacted with mechanical immersion vibrators of types approved by the Engineer.

The immersion vibrators shall produce a vibration frequency of not less than 6000 impulses per minute. Under no circumstances shall the immersion vibrators be allowed to come into contact with reinforcement or shuttering. Immersion vibrators shall penetrate vertically for a few inches into any previous unset layer in order to establish a satisfactory bond, but no concrete shall be vibrated in such a manner as to cause injury to concrete (already set or otherwise) in other parts of works. Care shall be taken to keep the vibrators vertical, to insert them at regular intervals and withdraw them slowly to prevent the formation of voids, so that the entire mass of the concrete is properly compacted. Haphazard or random penetration of the vibrators without sufficient depth of insertion shall be avoided. A sufficient number of vibrators shall be used to ensure compaction of each batch of concrete before the next batch is delivered. At least one extra vibrator shall be in hand for emergency use.

Vibration shall be supplemented by hand punning with approved small-diameter

smooth steel rods with rounded ends in order to achieve complete compaction around reinforcement and other embedded fittings and a completely dense mortar finish against the shuttering.

Excessive vibration shall be avoided and vibration shall not be continued after a good surface finish, without free water, has been achieved. Vibration and punning shall be just sufficient to produce a dense, homogeneous concrete properly filling the moulds and free from air voids, segregation, bleeding, honey combing and other imperfections. Only highly skilled operators and workmen, subject to constant supervision, shall be employed in vibrating and punning concrete.

2.13.1 Time Interval between Mixing and Placing

Concrete mixed in stationary mixers and transported by non-agitating equipment shall be placed within thirty minutes after it has been mixed, unless otherwise authorized. When a truck mixer or agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be completed within 1 1/2 hours after introduction of the cement to the aggregates. The concrete shall be placed within 20 minutes after it has been discharged. In all cases, concrete shall be placed and compacted well within the initial setting time.

2.14 CONCRETE FINISHES

Concrete fishes shall be made in accordance with the provision of ACI 301-8 or as directed by the Engineer

Workmanship in shuttering and concreting shall be such that concrete work shall normally require retouching and the surfaces being dense, watertight and where steel shuttering has been used, perfect and smooth. Should there be faults in these respects, the Contractor shall cut out and replace the whole of the lift concerned or such amount as the Engineer decides, or make good if permitted by the Engineer and to his approval. Concrete which is honey-combed or otherwise shows voids shall invariably be cut out and replaced in an approved manner as suggested by the Engineer.

Any making good shall be carried out immediately after striking the shuttering and shall be restricted to light rubbing down with wet carborundum or the approved correction of minor blemishes. In no circumstances shall surfaces be made good with cement or washes or rendering.

Exposed concrete surfacing not requiring shuttering and not subsequently to be given extra finishes shall be given perfectly dense smooth finish with a wooden float.

Where concrete slabs, ducts, bases or machine plinths will themselves form the finished floor surface the concrete shall be troweled immediately after the first laying process only just sufficiently to give a level surface. Thereafter, when the concrete has stiffened to a condition such that a hard compacted surface can be obtained without bringing up laitance, a final surface troweling shall be given with a steel float to produce a smooth finish.

2.15 CONCRETE AND WEATHER

No concrete shall be placed when the atmospheric temperature is below 15 degree centigrade without the written permission of the Engineer. When directed by the Engineer the Contractor shall provide adequate means for maintaining a temperature of not less than 20 degree centigrade for 3 days or 15 degree centigrade for five days after placing the concrete.

If Rapid-Hardening Portland Cement is used, the period may be reduced as directed by the Engineer.

The Contractor shall supply such heating apparatus as stoves salamanders or steam equipment and the necessary fuel. When dry heat is used, means of maintaining atmospheric moisture shall be provided. All aggregates and mixing water shall be heated to temperature of at least 20 degree centigrade, but not more than 75 degree centigrade, the aggregates may be heated by either steam or dry heat, if permitted by the Engineer the torch method of heating mixed aggregate shall be such as to heat the mass uniformly and avoid spots which will burn the materials. The temperature of the concrete shall be not less than 10 degree centigrade at time of placing in the forms.

In case of extremely low temperature, the Engineer may, at his discretion, raise the minimum limiting temperature of water, aggregates and mixed concrete. When the shade temperature is above 32 degree centigrade, special precautions shall be observed during concreting to the satisfaction of the Engineer. Concreting will be permitted when it is not raining. Thermometer shall be kept at the Site by the Contractor.

2.16 CURING OF CONCRETE

Unless otherwise specified or ordered by the Engineer all concrete shall be cured by water. It shall be kept wet continuously for at least fourteen days after placement. It shall be covered with water saturated material like gunny bags, canvas, clean sand, matting, etc. or any other improved method duly approved by the Engineer.

In order that tensile stresses on the cooling of concrete shall be kept to a minimum, all materials shall be as cool as practicable when mixed and placed. To this end, aggregates shall be covered, coarse aggregates shall be cooled with

water and mixing plant etc., water storage tanks and pipelines shall be covered or insulated from the effects of the sun. The temperature of concrete on placing shall in no case exceed 32 degree Centigrade.

Concrete shall be placed only against surfaces which are damp and no such work shall be started until arrangements for keeping the shuttering continuously cool and wet are in place. Shuttering and exposed faces of concrete and mortar shall be covered by at least 3 thicknesses of approved stout hessian kept continuously cool and wet by an efficient and comprehensive system of sprinklers and diffused jets of water, with appropriate temporary drainage arrangements, for at least 14 days after placing.

As an alternative to continuous curing with water after stripping of shuttering a proprietary membranes method of curing may be used provided that it is used strictly in accordance with the manufacturer's instructions, is coloured to show its presence, contains no bituminous substance, does not prejudice the appearance of permanently exposed concrete surfaces and is in all other respects to the approval of the Engineer. Wherever practicable, both faces of concrete structures shall be appropriately treated in order to prevent tensile stresses due to differential shrinkage or temperature across the section. Further more, the Contractor shall continue to provide facilities for covering and/or keeping wet such exposed surfaces of the Work as are, in the opinion of the Engineer liable at any time to be damaged by weather.

At no time shall any further work involving concrete proceed until the Contractor has satisfied the Engineer that all such work previously carried out is being protected and cured in accordance with this clause.

2.17 CONCRETE IN EXCAVATION AND FILLING

Before concrete is placed in or against any excavation or filling, the surface of such earthwork shall have been compacted and shall be free from running and standing water, oil and other deleterious matter. Loose earth and other material shall be removed. The excavation or filling shall be damp but not wet and special precautions shall be taken to prevent groundwater from damaging unset concrete or causing movement of the concrete.

Immediately after the excavation or filling has been trimmed and prepared as above, the exposed foundation shall be protected by a blinding layer or "No-fines" concrete or of cement mortar or other protection as shown on the Drawings or ordered by the Engineer. Such blinding layers and coatings shall be thoroughly cleaned and moistened before further concrete work is placed thereon.

Reinforced concrete shall not be cast against an unprotected face of earth or any other material liable to become loose or to slip; the greatest possible care shall be taken to avoid falls of material on to the concrete, by leaving the timbering in place (if permitted) or by removing the timbering in small depths and lengths at a

time and by any other approved means. If any such falls occur, all soiled concrete shall be removed and replaced at Contractor's own cost.

2.18 SHUTTERING

The Contractor shall submit, for the approval of the Engineer full proposals and design calculations for all shuttering and proposals for the period of time to elapse before each item of the shuttering is struck. Not withstanding the approval of the Engineer to any actual shuttering or proposals for its striking, the Contractor shall retain complete responsibility for its adequacy as to the provisions of this clause and for any consequences of the striking being premature or harmful. In general the minimum time for the removal of form work shall be as under:

	Form Work	Removal Time	Normal Weather above 15°C
a)	Form work of vertical surfaces such as Beams side walls and columns	4 days	2 days
b)	Slabs, props left under	10 days	5 days
c)	Props to slab	14 days	10 days
d)	Beam soffits, prop left under	14 days	7 days
c)	Removal of props to Beams	21 days	21 days

Shuttering shall be designed with easily sealed access hatches for inspection purposes and for removal of water and deleterious materials, and with connections to facilitate striking without damaging the concrete. When props are to be left in position under slabs the shuttering shall be made and removed in such a way that the props are not disturbed in any way.

A tolerance of plus or minus 1/8 inch in line or level will normally be permitted after erection of the shuttering which shall nevertheless be sufficiently strong, stiff and rigidly braced against loads due to the wet concrete and vibration and against constructional loads, to remain true to the line and level accepted before concreting. It shall be sufficiently watertight to ensure that there shall occur no "fine" or escape of mortar at joints or of liquid from the concrete.

All exterior angles for concrete work not permanently burried in the ground shall

be given 3/4" x 3/4" chamfers unless otherwise indicated on the Drawings.

Timber for shuttering shall be well seasoned, free from loose knots, splits, projecting nails and the like and from any adhering foreign matter.

Steel shuttering shall be used to produce a fair face concrete with only a faint but consistent pattern of plate marks on exposed concrete surfaces. The shuttering shall be assembled from wrought tongued and grooved boarding, true and tightly fitted with joints as necessary, the whole surface and all edges being rendered smooth before and after oiling. Bearing in mind the quality of the finish required, wrought, plain-edged and butt-joint boarding may replace the tongued and grooved boarding or purpose-made steel- faced shutters of first-class quality may be used, solely at the discretion of the Engineer.

Rough shuttering shall be used for surfaces to be buried in the ground and shall be assembled from sawn boards with smooth and true edges or from approved steel shutters. In either case all joints shall be suitably filled.

The inside faces of all shuttering shall be treated with an approved material to prevent adhesion of the concrete, all such materials being kept clear of the reinforcement and other items to be embedded.

Shuttering shall be struck by static force alone without shock and vibration causing any damage to the concrete. Shuttering being reused shall be thoroughly repaired and cleaned before re-assembly.

2.19 WATER STOPPER'S

2.19.1 Scope

The work to be done under this item consists of providing and installing PVC/Metal water stops as shown on the Drawings or as directed by the Engineer.

2.19.1 (a) Polyvinylchloride Water Stopper

Polyvinylchloride water stopper shall be extruded from an elastomeric plastic compound, the basic resin of which shall be polyvinylchloride (PVC) The compound shall contain such additional resins, plasticizers, stabilizers or other materials needed to ensure that when the material is compounded and extruded to the shapes and dimensions shown, it will have physical characteristics when tested by the U.S. Corps of Engineers Tested Method specified below:

Physical Characteristics	No of Specimens Tested	Requirement	USCE Test Method

Tensile strength using die III, not less than	5	1750 psi	568
Ultimate elongation using die III, not less than	5	350%	573
Low temperature brittleness, no sign of failure such as cracking or chipping at	5	-35°F	570
Stiffness in flexure, 1/2 inch span, not less than	3 571	400	psi

Installation

The PVC Water stops shall be laid in continuous lengths. Splices in the continuity or at the intersections of runs of PVC water stops shall be performed by heat sealing the adjacent surfaces in accordance with the manufacturer's recommendations or as directed by the Engineer. A thermostatically controlled electric source of heat shall be used to make all splices. The correct temperature at which splices should be made will differ with the material used but should be sufficient to melt but not char the plastic. After splicing, a remolding iron with ribs and corrugations to match the pattern of the water stopper shall be used to reform the ribs at the splice. The continuity of the characteristic components of the cross section of the water stopper design (ribs, tubular center axis, protrusions, and the like) shall be maintained across the splice.

2.19.1 (b) Metal Water stopper

Copper, stainless steel and steel water stopper shall be installed in joints at the locations shown on the Drawings. The thickness, shape, dimensions and splicing of metal water stopper shall be as shown on the Drawings or as approved by the Engineer.

2.20 TERRAZZO WORK

2.20.1 Scope

The work to be done under this item consists of providing terrazzo finish inside

the water tanks and at any other place shown on the Drawings. The subgrade shall comprise of (i) cement plaster (ii) cement concrete.

2.20.2 Material

Marble Chips of the specified grade, and colour shall be of approved quality obtained from quarries in Pakistan. Before any material is purchased, the Contractor shall submit to the Engineer for approved samples in duplicate. The material used in the work shall correspond with the approved samples, in quality, colour texture and finishes etc.

2.20.3 Subgrade

The subgrade under terrazzo top shall be 3000 psi cement concrete or1:2 cement sand plaster of the thickness specified on the Drawings. The subgrade shall be constructed in accordance with the applicable stipulations and requirements, Cement Plaster of the Specifications. The subgrade surface shall be kept wet for proper adhesion of terrazzo topping, which shall be laid when the subgrade has still not hardened.

2.20.4 Topping

Terrazzo top finishing of thickness as shown on the Drawings or the Finishing Schedule shall consist of marble chips and cement mixed in ratio of 1:2 (one part grey cement and 2 parts chips of approved grading and shade with admixture of approved pigment). Terrazzo topping shall be laid true to the pattern as given on the Drawings or as directed by the Engineer. The terrazzo topping shall be well compacted and all voids and dips made good.

2.20.5 Final Finish

Smooth Finish: After 48 hours of laying the terrazzo topping requiring smooth finishes shall be grinned with No.80 Carborundum stone until the marble chips are evenly exposed.

After the first grinding neat coat of suitably coloured cement slurry be applied to repair the pores if any, formed during the course of grinding and cured for 24 hours. The second and the third grinding shall be suitably carried out with grinding stone ranging from No. 80 to 240 respectively. Electric grinders shall be used to ensure that the grinding is adequate.

The surface after all chips have been evenly exposed will be cured for one week and left undisturbed for another week. After this period the surface shall be cleaned of dirt and dust by rubbing gently with pumice stone with sufficient water. If this treatment is not successful in removal of the white scum or other materials and hardened deposits, the floor shall be lightly rubbed with grinding stone while washing soda solution is being used. it would then be treated with

oxalic acid (1:10) solution using felt or an old blanket. After oxalic acid treatment the surface shall be cleaned and washed with plenty of water and dried.

2.21 STEEL REINFORCEMENT

2.21.1 Scope

The work to be done under these items shall include furnish, cut, bend, and place all steel reinforcement as indicated on the Drawings or otherwise required. All reinforcement when surrounding concrete is placed shall be free from loose, flaky rust, and scale, and free from oil grease or other coating which might destroy or reduce its bond with the concrete. All placing shall be in accordance with Drawings furnished or approved. The use of reinforcement for the transmission of current for welding will not be permitted. All reinforcement, including dowels, remaining exposed in the work shall be suitably protected until embedded in concrete.

2.21.2 Cutting and Bending

Steel reinforcement may be mill or field cut and bent. All bending shall be in accordance with standard approved practice and by approved machine methods. When bending is required, it shall be performed prior to embedding the bars in the concrete. In all such cases, the bars shall be cold bent. Bending or straightening of bars partially embedded in set concrete shall not be permitted except in isolated cases where corrective action or a field change is required and is specifically approved by the Engineer.

2.21.3 Quality

Concrete reinforcement bars shall be of following quality:

Intermediate grade Steel: It shall be deformed bars conforming to ASTM 615-81(a,b) grade 40/ grade 60 or equivalent having a minimum yield strength of 40,000 psi/ 60,000 psi. The Contractor shall provide labour, materials, arrange measuring and testing facilities to ascertain quality, weight or quantity of steel at his own expense, No steel shall be incorporated in the Works without prior approval of the Engineer.

2.21.4 Spacing of Bars

The spacing of bars shall be as shown on the Drawings or as directed by the Engineer. The variation from indicated spacing, provided that the total area of reinforcement is in accordance with the Drawings, shall not be more than 1 inch.

2.21.5 Relation of Bars to Concrete Surface

The cover of all main reinforcement shall conform to the dimensions shown on

the Drawings. The protective covering shall not be less than, and shall not exceed more than 1/4" from the values specified on the Drawings, indicate the clear distance from the edge of the main reinforcement to the concrete surface. The concrete covering of stirrups spacer bars, and similar secondary reinforcement may be reduced by the diameter of such bars.

2.21.6 Splicing

Except as otherwise shown on the Drawings or specified herein, all splices, lengths of laps, splice locations, placement and embedment of reinforcement shall conform to the applicable requirements of American Concrete Institute 318-77, Building Code Requirements for Reinforced Concrete. All splices and locations of laps in reinforcement shall be as shown on the Drawings or as directed by the Engineer. Additional bar splices shall be provided as required, subject to approval of the Engineer. Lapped ends of bars may be placed in contact and securely wired or may be separated sufficiently to permit the embedment of the entire surface of each bars by butt-welding or by approved mechanical methods such as the Cadweld splice or other type splice using positive connectors shall be adopted where indicated or directed by the Engineer. Butt welding of reinforcing bars, where indicated or directed shall conform to the requirements of American Welding Society's Recommended Practice for Welding Reinforcing Steel, Metal Inserts and Connections, D.12.1. Concrete shall be protected from heat during welding operations.

2.21.7 Supports

All reinforcement shall be secured in place by use of metal or concrete supports, spacers, or ties, as approved by the Engineer. Such supports shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operation. The supports shall be used in such a manner that they will discoloration or deterioration of the concrete. Concrete supports shall be manufactured of the same concrete mix as used in the structure to be concreted.

2.22 MEASUREMENT AND PAYMENT

Measurement and payment for concrete, reinforcement, precast concrete, PVC water stop and Terazzo/Mosaic work will be made in accordance with the provisions of this clause specified hereinafter.

2.22.1 Method of Measurement

Concrete will be measured for the number of cubic feet acceptably placed complete in all respects as per Drawings and in strict accordance with this section of specification.

Measurement for steel reinforcement will be made of number of Tons of reinforcing steel acceptably placed on the basis of the lengths of bars installed in accordance with the approved Drawings or bar schedules or as directed, converted to weight for the size of bars listed by the use of unit weights per linear foot as follows:

Bar Size	Unit Weight lbs. per foot
1/4"	0.167
3/8"	0.376
1/2"	0.668
5/8"	1.043
3/4"	1.502
7/8"	2.044
1"	2.670
1 1/8"	3.775
1 1/4"	4.172
1 3/8"	5.049

Steel in laps and embedments indicated on the Drawings or as required by the Engineer will be paid for at the steel unit price. No measurement for payment will be made for the steel consumed in providing supports and for the additional steel in laps which are authorised for the convenience of the Contractor.

Polyvinylchloride water stop of the size and gauge as shown on the Drawings will be measured for the number of linear feet acceptably placed in the work. In computing the quantities, no allowance will be made for laps.

Measurement for terrazzo/mosaic work will be made in square feet as shown on the Drawings.

2.22.2 Basis of Payment

Payment will be made in accordance with the unit prices in the Bill of Quantities for the various items in accordance with the specifications and shall constitute full compensation for furnishing all materials, shuttering, equipment and labour and for performing all operation necessary to complete the work.

Description	Unit

Provide and lay concrete		Cft.
Furnish and Fix Reinforcing Steel		Tons
Furnish and Install Water Stop		
(i)	PVC	Lft.
(ii)	Stainless Steel	Lft.
Provide and Lay Terrazzo/Mosaic Work		Sft.

SECTION - 3

BRICK AND CEMENT CONCRETE BLOCK WORK

3.1 SCOPE

This section consists of construction of brick/ cement concrete block work walls of any thickness with first class hand-mould and/or machine pressed bricks/cement concrete blocks with the specified ratio of cement mortar in foundation, plinth superstructure or for any other structure as directed by the Engineer, or shown in the Bid Schedule. The Contractor shall furnish all materials and all other requirements to produce finished brick/block work. Brick/block work and materials for brick/block work shall be in strict accordance with this section of the specifications and applicable drawings and subject to the terms and conditions of the Contract.

3.2 MATERIALS

3.2.1 Portland Cement

Portland cement shall conform to the stipulations and requirements set forth in Section "CONCRETE".

3.2.2 Mortar Sand

Sand for mortar used in construction of brickwork/blockwork required under these Specifications shall be furnished by the Contractor in accordance with the provisions and in conformity with the stipulations and requirements of ASTM Designation C144-70 or latest revision and shall have a fineness modulus between 1.6 to 2.5.

3.2.3 Water

The water used in the preparation of mortar shall be free from objectionable quantities of silt, organic matter, alkali salts and other impurities and it will be tested in accordance with BS-3148 and approved by the Engineer at the Contractor's cost.

3.2.4 Aggregate

Aggregates for mortar shall comply with the requirements of ASTM C144. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the Engineer.

3.2.5 Additives

Additives where used, shall be proprietary products used in the proportions and manner recommended by the manufacturer. The additives shall in no way adversely affect the mortar strength or contain chemicals, which may e harmful to other building materials. To add gypsum to cement is strictly forbidden.

3.3 MORTAR AND GROUT

Materials for mortar, sand binding agent and water shall be mixed by volume for at least 3 minutes with the minimum amount of water to produce a correctly mixed mortar or grout of workable consistency in a mechanical batch mixer. For small jobs, hand mixing may be permitted, the ingredients being mixed with sufficient water to produce a correctly mixed workable mortar. Mortar used in masonry construction shall conform to ASTM C-270 standard.

Mortars shall be mixed in batches, which can be used within a period before the setting process commences. Once a mix begins drying off, it shall be rejected. No ingredients shall be added to it once the setting process has begun. Mortar shall not be retained for more than 30 minutes and shall be constantly worked over with hoe or shovel until used.

3.4 MORTAR BATCHING

Methods or equipment used for mixing mortar shall be such as will accurately determine and control the amount of each separate ingredient entering into the mortar and shall be subject to the approval of the Engineer. If a mixer is used it shall be of approved design and the mixing time after the ingredients are in the mixer, except for the full amount of water, shall not be less than two minutes.

Mortar shall be mixed only in sufficient quantities for immediate use and all mortar not used within 30 minutes after addition of water to the mix shall be wasted. Retampering of mortar shall not be allowed. Mixing pans and troughs shall be thoroughly cleaned and washed at the end of each day's work.

3.5 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 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.

3.6. JOINTING

Jointing is the forming of joints as work proceeds. Joints shall be as follows:

3.6.1 Exterior exposed joints shall be tightly formed to a weather joint with the point of the trowel.

3.6.2 Interior exposed joints shall be tightly formed to a concave joints.

3.6.3 Joints which are subsequently covered with plaster or other finish materials shall be struck flush.

3.7 BRICKS

The bricks used shall be of standard size (9"x4.5"x3") first class well burnt, uniform in shape, size, texture, colour and should produce a ringing sound when struck. The bricks shall be free from flaws, cracks, chips, stone nodules of lime or kan-kar or any other blemishes. The brick shall not absorb more than one sixth of its weight when soaked in water for one hour. Compressive strength shall not be less than of 1400 psi. Bricks over burnt, under burnt vitrified and irregular shall not be used. Bricks of uniform size shall be used throughout the work and source of supply shall not be diversified.

3.7.1 Soaking

Before use all bricks shall be soaked in clean water in tanks or pits for at-least two hours.

3.7.2 Laying of Bricks

All brickwork shall be skillfully laid with level courses, uniform joints, square corners, plumb verticals and true surfaces except when otherwise shown on the Drawings or directed by the Engineer. Brickwork will be of best standard of workmanship obtainable and objectionable offsets in the brickwork shall be avoided. Smoothest practicable finished surface of the brickwork shall be ensured. Unless otherwise specified bricks shall be laid in English Bond with frogs (Manufacturer's marks) upward.

All horizontal joints shall be parallel and truly level. Vertical joints in alternate coarses shall come directly over one another. Thickness of joints unless otherwise specified shall not be less than 1/4 of an inch and not more than 3/8 of an inch. The height of 4 coarses and 3 joints as laid shall not exceed by more than 1 inch the height of 4 bricks as piled one upon the other.

3.7.3 Curing

All brick work involving use of cement shall be cured by water curing or other acceptable methods. The Engineer shall approve all methods and operations of the Contractor in curing different portions of work.

When curing by water brickwork shall be kept wet for at least 14 days by covering with water saturated materials or by a system of perforated pipes, mechanical sprinklers, porous hose, ponding or by any other approved method which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements given in Clause 3.2 of these specifications.

3.8 BLOCKS

Cement, aggregates and water for concrete blocks shall conform to the requirements as specified in the section for plain and reinforced concrete or as approved by the Engineer.

3.8.1 Concrete Block Making

3.8.1.1 The solid and hollow blocks as and where used by planning, 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 manufactures.

3.8.1.2 The blocks shall be continuously water cured by sprinkling water for a minimum of 10 days and covered between sprinkling operations with 4 mils thick polyethylene sheeting. After the 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 surfaces of the block will be allowed to dry.

3.8.1.3 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.

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

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

3.8.2 Properties of Blocks

3.8.2.1 All blocks shall be of size and shape required to complete the work shown in the Drawings or as instructed by the Engineer.

3.8.2.2 The cement, sand and coarse aggregate shall be volume batched and their proportion may be adjusted so as to provide the concrete of the required strength when tested and shall be mixed in a concrete mixer.

3.8.2.3 All blocks shall conform to ASTM C 145 standard. The compressive strength based on gross area shall be minimum 8.30 MPa for an average of 3 blocks and minimum 7.0 MPa for lowest individual blocks with 28 days after casting Cement Concrete Solid Blocks.

3.8.2.4 The Contractor shall provide test certificates show in the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test certificates shall be provided as required by the Engineer, to ensure that all batches of block strengths are to be determined in accordance with ASTM C- 140 Standard.

3.8.2.5 The test shall be carried out by a laboratory approved by the Engineer. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The Engineer will require to test samples of blocks periodically and the Contractor shall make necessary arrangements accordingly. The method of sampling for all test shall be in accordance with ASTM C-140.

3.8.2.6 All properties or specifications of blocks, not explain in these Specifications or ASTM C 145 shall comply with the requirements of PS 419, as directed by the Engineer.

3.8.3 Soluble Salt Content

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

3.8.4 Erection

3.8.4.1 Block shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at centre of units in alternate courses below. Vertical joints shall be buttered in the entire height of blocks. Each course shall be bonded. Courses of block shall be kept plumb throughout and corner reveals shall be true and in plumb.

Standard with of mortar joints for both horizontal and vertical joints shall be 7/16 inch (maximum). Mortar joints in wall 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. Blocks terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joints shall be packed solidly with mortar between the top of the block and the bottom of slab or beam.

Control expansion joints shall e 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 hold fasts shall be filled in with Class C 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.

3.8.4.2 The block work shall be carried out in a uniform manner and no portion shall be carried more than one metre above the adjoining one at any times. All masonry shall be kept strictly true and square and the whole properly bonded together and levelled round each floor.

3.8.4.3 Sleeves, Chases, holes, sinking and mortices for other trades shall be correctly located and formed to the sizes as required by the relevant trades. Chiselling of completed walls or the formation of holes shall only be carried out with the approval of the Engineer.

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

3.8.4.5 All bolts, anchors, ties, pipe sleeves, flushing metal attachments lintels and the like required to be built into the work shall be correctly inserted and executed as the work proceeds.

3.8.4.6 Walls or partitions abutting concrete columns or walls shall be securely anchored and tied with metal anchors or ties at not more than 18 inches vertical centres. Wall ties cast in with concrete shall be bent down after the removal of form work and shall be securely jointed into the mortar beds of walling.

3.8.5 Curing and Repairs

3.8.5.1 All block masonry shall be water cured and shall be kept wet for at least seven days, by an approved method, which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements of specifications for water used in the manufacture of blocks.

3.8.5.2 Tolerances

All block work shall be erected plumb and true to line and level with the maximum variation in any storey height or any length of wall being one mm in one metre. The maximum tolerance in the length, height or width of any single masonry wall shall be $\pm$ 1/8 inch.

3.8.5.3 If, after the completion of any block masonry work, the block is not in alignment or level, or does not, conform to the lines and grades shown on the Drawings or shows a defective surface, it shall be removed and replaced by the Contractor at his expense unless the Engineer grants permission, in writing, to patch or replace the defective area.

3.9 MEASUREMENT AND PAYMENT

3.9.1 Material (Brick and cement concrete block work)

Measurement and payment for brick/cement concrete blockwork shall be made in accordance with the provisions given hereafter.

3.9.1.1 Method of Measurement

Measurement for brick/block work shall include number of cubic ft. of brick/block work provided within the limits as shown on the Drawings or as directed by the Engineer.

3.9.1.2 Basis of Payment

Payment for brick/block work shall be made at the contract unit price per cubic feet. Payment shall constitute full compensation for furnishing all materials, equipment and labour including all incidentals necessary to complete the work:

D e s c r i p t i o n	**Unit**
Provide and Lay Brick Masonry with cement sand mortar in foundation and super structures.	Cft.
Provide and Lay Block Masonry with cement sand mortar in foundation and super structures.	Cft.

SECTION - 10

WATER SUPPLY PIPES, PIPE LAYING AND APPURTENANCES

10.1 SCOPE

The work covered by this Section of the specification consists of furnishing all plant, labour, equipment, appliances and materials and of performing all operations in connection with water supply lines and appurtenances in strict accordance with this section of the specifications and the applicable Drawings.

10.2 MATERIALS

Material shall conform to the respective specifications and other requirements specified hereinafter and shall be new and unused.

10.2.1 Cast Iron Pipes and Fittings

Cast iron pipes and fittings shall comply with BS 78 for spigot and socket vertically cast pipes, BS 1211 for spigot and socket spun iron pipes and BS 2035 for flanged pipes.

10.2.2 Galvanized Iron Pipes and Fittings

The galvanized iron pipes shall strictly conform to BS 1387-1967 "medium quality" Specifications for "Steel Tubes and Tubulars suitable for screwing to BS 21 pipe threads". All screwed pipes and sockets shall be of wrought iron have BS 1740. A complete and uniform adherent coating of zinc white will be provided for galvanized iron pipes and fittings.

10.2.3 Unplasticised Polyvinyl Chloride Pipe and Fittings

Unplasticised polyvinyl chloride (uPVC) and fittings if approved by the Engineer shall confirm to BS 3505 pipes shall be class B: Pipe and fittings shall not be stored directly exposed to sunlight handled or laid in conditions where ambient temperatures may cause distortion or damage. In extreme conditions, pipe and fittings may have to be stored under water.

10.2.4.1 Joints for Unplasticised Chloride Pipe

Joints for unplasticised polyvinyl chloride pipe shall be the Z type consisting of a socket with rubber gasket, or approved equal, and assembled in accordance with the pipe manufacture's recommendations.

10.2.4 Mild Steel Pipes

The mild steel pipes shall conform to BS 1387-1967 "medium quality"

Specifications for "Steel Tubes and Tubulars". All pipes shall have thickness suitable to withstand the working pressure as specified in the Bill of Quantities.

10.2.5 Polyethylene (P.E) Pipes and Fittings

High-density polyethylene pipes (HDPE) and fittings shall conform to ISO 4427/DIN 8075 standards. Material, diameters, wall thickness shall be as indicated in 4427/DIN 8074. Tests to be performed for pipes shall be Heat revision, Short term hydrostatic pressure test and Tensile strength and for P.E. compounds shall be Elongation at break, Melt flow rate and Density test.

Warning tape shall be provided for lying over P.E. pipes. It should be single fold, 0.02 inch thick and 2 inch wide, with warning for digging continuously printed in Urdu language. The tape shall be placed one foot above the P.E. pipe.

Bricks on edge shall be placed on the P.E. pipes along its edge after it is laid in order to avoid any damage to the pipe.

10.2.6 Sluice/Gate Valve

Valves shall be wedge gate valves/check valve conforming to British Standard Specification 5163 : 1974. Ends of valves shall be suitable for the type of pipe to which the valves will be connected. The direction of flow should be marked by arrow on the body of the valve.

10.2.7 Check Valve

Check valve shall comply with the requirements of BSS 5153 : 1974 or equivalent. The valve shall be of swing type and shall be of quick acting single door type.

10.2.8 Fire Hydrants

The metal of the fire hydrant shall conform to BS 750 (Type-2) and shall be of screw down streamline pattern. The body shall be best quality, closed grain, grey cast iron with spindle of manganese bronze having tensile strength of not less than 11.0 tons per square in machined from solid rolled bars. The seating valves and other parts shall be of best quality gun metal with Brinell Hardness No. 80. The direction of closing shall be by clockwise rotation and outlet shall have fire hose threads for accommodation of 2 1/2" dia hose connection. Inlet flanges of hydrant shall be suitable for jointing with flanges of hydrant bends and tees. All fire hydrants shall be coated with one coat of primer and two coats of signal red enamel paint approved manufacturer to give a uniform protective coating on cast iron.

10.2.9 Ferrule Assembly

Ferrule assembly shall consist of brass ferrule assembly including corporation cock for disconnection of approved quality including PP saddle, PP strap, and all other items related to make complete house connection.

10.2.10 Surface Boxes

The surface boxes shall be manufactured as per Drawings. Cover and frame shall be of cast iron.

10.3 APPROVAL OF MATERIALS AND EQUIPMENT

As soon as practicable but within 30 days after receipt of notice to proceed and before any materials or equipment are purchased, the Contractor shall submit for approval of the Engineer a complete schedule, in triplicate, of materials and equipment to be incorporated in the work, together with the names and addresses of the manufacturers and their catalogue cuts, diagrams, drawings, and such other descriptive data as may be required by the Engineer. No consideration will be given to partial lists submitted from time to time. Approval of materials and equipment with deviations from the specifications shall not be construed as approval of the deviations unless they are specifically brought to the notice of the Engineer. Laboratory results and certifications, specified or otherwise required, shall be submitted prior to delivery of the material and equipment to site.

10.4 INSTALLATION

10.4.1 Handling

Pipe and accessories shall be handled in such a manner as to ensure their delivery to the trench in sound, un-damaged condition. If any pipe or fitting is damaged, the repair or replacement shall be made by the Contractor at his expenses in a

satisfactory manner. No other pipe or material of any kind shall be placed inside of a pipe or fittings. Pipe shall be carried into position and not dragged. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Employer. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place and protected against the direct rays of the sun.

10.4.2 Cutting of Pipe

This shall be done in a neat and workman-like manner without damage to the pipe. Unless otherwise authorized by the Engineer or recommended by the manufacturer, cutting shall be done with a mechanical cutter of approved type. Wheel cutters shall be used wherever practicable.

10.4.3 Location

Where the location of the water pipe is not clearly defined by dimensions on the Drawings, the water pipe shall be located as directed by the Engineer.

10.4.4 Deflection

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets will be as recommended by the manufacturer and as approved by the Engineer. If the alignment requires deflections in excess of the specified limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit setforth, as approved.

10.4.5 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick ropes, belt slings, or other suitable equipment. Under no circumstances shall any of the water line materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers shall be of wood and shall have broad flat faces to prevent damage to the pipe. Except where necessary in making connections with other lines or authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bell coupling and joints. Pipe that has the grade or the joint disturbed after laying shall be taken out and relaid. Pipe shall not be laid in water shall be kept out of the trench until the materials in the joints have hardened or until chalking or jaunting is completed. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substances will enter the pipes or fittings. Where

any part of a coating or lining is damaged, the repair shall be made by the Contractor at his own expense in a satisfactory manner. D.I pipes shall be installed in accordance with recommendations of the pipe manufacturer. Pipe ends left for future connections shall be provided with valve, plugged or capped, and anchored, as shown or as directed, where connections shall be made by using specials and fittings to suit the actual conditions.

10.4.6 Jointing

a. The joints shall be in accordance with the recommendations of the manufacturer or as approved by the Engineer.

b. Connections between different types of pipes and accessories shall be made with transition fittings where recommended by the pipe manufacturer.

c. Service connections shall be made as indicated and in accordance with the recommendations of the pipe manufacturer.

10.4.7 Setting of Fire Hydrants, Valves and Surface Boxes

Fire hydrants shall be located and installed, as shown. Hydrants shall be set plumb and in accordance with the manufacturer's instructions.

Valves and surface boxes shall be installed as shown or directed, and shall be set plumb. Surface box shall be centered on the stems. Concrete, concrete pipe, brick, brick ballast used in chambers shall conform to the relevant clause of the Specifications. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be carefully tamped around each valve box to the satisfaction of Engineer on all sides of the box, or to the undisturbed trench face if less than 4 ft.

Hydrants and valves shall have the interiors cleaned of all foreign matter before installation. Surface boxes shall be lighted and the hydrant or valve shall be inspected in open and closed positions to ensure that all parts are in working condition.

10.4.8 Thrust Blocks

Plugs, caps, tees, bends and fire hydrants shall be provided with concrete thrust blocks. Backing shall be placed between solid ground and the hydrant or fitting to be anchored. The area of bearing shall be as shown on the Drawing. The backing shall be so placed that fitting joints shall be accessible for repair. The concrete shall be of class B plain cement concrete.

10.5 FLUSHING

The Contractor shall provide facilities for flushing the line. Water for flushing the line shall be arranged by the Contractor. Flushing of line shall be done section by section. For each valved section of pipeline, the Contractor shall make a temporary hose connection between the water pipeline and the pipeline under test. Water shall be pumped into the section flushed. Other arrangements for storing and pumping of water shall be subject to the approval of Engineer. Due precautions shall be taken by the Contractor for the disposal of water. The pipeline shall be flushed by keeping all the branch pipes open. Flushing shall be continued until clean water starts flowing through the other end. Section by section, the entire pipeline shall be flushed at a minimum flushing velocity of 2.5 ft./sec.

10.6 LEAKAGE TEST

Flushing of the pipeline shall be followed by a leakage test. The Contractor shall provide facilities for performing the leakage test. Water and pumping facilities shall be provided by the Contractor. Before the testing of pipeline, the Contractor shall ensure that concrete backing blocks have been provided where necessary. The test shall be performed only after all concrete work in contact with pipe to be tested has set for a minimum of 72 hours. All joints shall be left exposed. Leakage test shall be performed by keeping the end of the pipeline closed by proper plugs blocked to resist 150 per cent of the actual working pressure. While filling the line all valves and openings shall be kept open and water shall be filled in slowly. When the pipeline is completely filled with water and all air expelled, water shall be pumped into the pipeline to a minimum pressure of 150 percent of actual working pressure and the test pressure shall be maintained for at least 30 minutes for each section of 330 feet. Each and every joint shall be inspected for leaks and for all visible leakage, a displacement leakage test shall be performed by the Contractor, for the newly laid pipeline. The pipeline shall be filled with water and all the air from the pipeline shall be expelled. No piping installation will be accepted until the leakage is equal or less than the number of imperial gallons per hour as determined by the formula:

$L = 0.00054.ND./P$
L = Leakage in Imperial Gallons
N = Number of joints
D = Nominal diameter of pipe in inches
P = Average test pressure (psi) during test

In the event of the pipeline failing the leakage test, the Contractor shall locate and repair the defective pipe, fitting or joint at his expenses. For dewatering the line for repairs the Contractor shall follow the instructions given by the Engineer for disposal of water. After repairs of the line, the Contractor shall retest the line. The line will not be accepted until it passes the leakage test.

10.7 RETESTING AFTER BACKFILL

After the pipe trench has been backfilled, the entire length shall be subjected to a leakage test as a whole unit. The Contractor shall repair the line if it fails to pass the leakage test requirements specified hereinbefore. The test shall be repeated and repairs affected until the pipeline passes the leakage test.

10.8 PIPELINE DISINFECTION

10.8.1 General

The Contractor shall furnish all equipment, labour and material for the proper disinfection of the pipeline. Disinfection shall be accomplished by chlorination after the lines have been successfully tested for leakage but before they have been connected to the main system. Disinfection of the pipelines shall be done in the presence of the Engineer's representative with equipment approved by him.

10.8.2 Chlorination

A chlorine and water mixture shall be supplied by means of a solution feed chlorination device. The chlorine solution shall be applied at one end of the pipeline through a trap, in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be atleast 25 ppm or enough to meet the requirements given hereinafter.

10.8.3 Retention Period

Chlorine solution shall be retained in the pipeline for a period of at least 24 hours. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe extremities and at such other representative points shall be at least 10 parts per million. This procedure shall be repeated until the required residual chlorine concentration is obtained.

10.8.4 Chlorination of Valves

During the process of chlorination of the pipeline, all valves or other appurtenances shall be operated while the pipeline is filled with the heavily chlorinated water.

10.9 FINAL FLUSHING

Following complete disinfection of the pipeline, all treated water shall be thoroughly flushed from the pipeline at its extremities. Treated water and water used for flushing the pipelines shall be disposed of in a manner instructed by the Engineer. Fresh treated water shall be filled in the line and water tested for presence of coliform. The test result should indicate negative coliform presence. If the test indicates any positive coliform, the entire process of disinfection shall be repeated or improved upon until coliform free samples are obtained.

10.10 WATER SAMPLING AND TESTING

Disinfection of the pipeline and appurtenances shall be the responsibility of the Contractor. The first set of samples will be collected for analysis by the Engineer. Should the sample reveal presence of coliform, the Contractor shall again disinfect the pipeline and appurtenance and shall pay the Owner for sampling and testing for subsequent retests until coliform free samples are obtained. The charges for resampling and retesting shall be paid by the Contractor.

10.11 CLEAN-UP

Upon completion of the installation of the water supply lines, distribution system and appurtenance, all debris and surplus materials resulting from the work will be removed and disposed of in a manner satisfactory to the Engineer

10.12 INDICATION PLATES

The indication plates shall be installed in accordance with the drawings and as directed by the Engineer.

10.13 WASHOUTS

The design and locations of washouts shall be illustrated on the Drawings and to be approved by the Engineer. Exact positioning shall be determined with regard to topography and to the approval of the Engineer. At least 10 ft. of the washout pipe work, inclusive of the isolating valve, measured from the center line of the pipeline, shall be laid at the same time as the pipeline and suitably capped to prevent ingress of foreign material. The minimum gradient for the washout pipe work shall be 1 in 100.

10.14 AIR VALVES

10.14.1 Double Orifice Air Valves

These shall be designed to meet the following conditions:

i) Expulsion of air during charging of the pipeline

ii) Admit air during emptying of the pipeline to avoid the occurrence of negative pressure

iii) Expulsion of air accumulated at summit points along the pipeline under normal operating conditions

Conditions (i) and (ii) shall be met by the employment of a large orifice capable of handling large volumes of air at high flow rate, and condition (iii) by a small

orifice capable of discharging small quantities of air as they accumulate.

The large orifice shall be sealed by a buoyant rigid ball and the chamber housing shall be designed to avoid premature closing of the valve by the air whilst being discharged. The small orifice shall be sealed by a buoyant ball at all pressures above atmospheric except when air accumulates in the valve chamber.

The nominal pressure shall be NP-10 for air valves on potable water lines and NP-16 for air valves on fire water lines.

10.14.2 Single Orifice Air Valves

These shall be designed to carry out the function described in 10.14.1 above. Each valve shall be provided with only a small orifice which shall operate in the same manner as that in a double acting air valve.

Valves with air intake or exhaust facilities shall have approved screening arrangements to prevent the ingress of air borne sand.

The nominal pressure shall be NP 10 for air valves on potable water lines and NP-16 for air valves on fire water lines.

Body ends shall be flanged with raised faces and drilled according to BS 10 for the nominal pressure specified or indicated in the Drawings.

The materials for the valves shall be as follows:

Cast iron body cover and bowl for small orifice, cast iron with gunmetal seat with rubber covered ball or other approved; for large orifice, cast iron with rubber seat and vulcanite covered ball or other approved.

10.15 MEASUREMENT AND PAYMENT

10.15.1 Pipe work

Measurement and payment of pipe work, fittings, specials and appurtenances will be made in accordance with the provisions of this clause specified hereinafter.

10.15.1.1 Method of Measurement

Measurement will be made for the number of linear feet of asbestos cement, galvanized iron, cast iron, unplasticised polyvinyl chloride and mild steel pipes acceptably provided & installed complete in all respects as per relevant Drawings and specification as directed by the Engineer.

10.15.1.2 Basis of Payment

Payment will be made for the number of linear feet of pipe work as measured above at the Contract Unit price of each unit and shall constitute full compensation to provide, handle, lay and joint asbestos cement, galvanized iron, unplasticised polyvinyl chloride, mild steel, cast iron pipes and including flushing, leakage testing before & after backfilling, final flushing and works related to the item.

D e s c r i p t i o n	**Unit**
Supply, lay, joint and test asbestos cement pipes complete with rubber rings and sockets as per drawings and specifications or as Directed by the Engineer.	Lft
Supply, lay, joint and test cast iron pipe complete in all respects as per drawings and specifications.	Lft.
Supply, lay, joint and test mild steel pipes complete in all respects as per drawings and specifications.	Lft.
Supply, lay, joint and test uPVC pipes, class B, fittings and accessories complete in all respects as per drawings and specifications.	Lft.
Supply, lay, joint and test galvanized pipes, fittings and accessories complete in all respects as per drawings and specifications.	Lft.
Supply, lay, joint and test polyethylene pipes, fittings and accessories including warning tape and bricks on edge complete in all respects as per drawings and specifications.	Lft.

10.15.2 Service Connection

10.15.2.1 G.I Pipe / Polyethylene Pipe

10.15.2.1(a) Method of Measurement

Measurement will be made for the number of linear foot of pipe including fittings acceptably provided & installed complete in all respects as per relevant Drawings or as directed by the Engineer.

10.15.2.1(b) Basis of Payment

Payment will be made for the number of linear foot of pipe work as measured above at the Contract Unit Price of each unit and shall constitute full compensation to provide, handle, lay, joint and test pipe, fittings, including sleeves, nuts, sockets, plugs, bitumen coating and all other work related to the item.

D e s c r i p t i o n	**Unit**
Provide & install galvanized iron pipe and all fittings including excavation and backfilling complete with sleeves, nuts, bends, sockets, elbows, plugs, bitumen coating and testing for making service connections.	Lft.
Provide & install polyethylene pipe and all fittings including excavation and backfilling complete with bends, sockets, elbows, plugs, and testing for making service connections with ferrule clamps etc as per drawing.	L.ft.

10.15.2.2 Ferrule Assembly

10.15.2.2(a) Method of Measurement

Measurement shall be made for the number of ferrules acceptably provided & installed complete in all respects as per relevant Drawings or specifications.

10.15.2.2(b) Basis of Payments

Payment shall be made for the number of ferrules measured as above at the contract unit price for each unit and shall constitute full compensation for providing, tapping, drilling, fixing including P.P straps, P.P Saddles, and all other work related to the item to make complete house connection.

Description	Unit
Provide & install brass ferrule assembly of approved quality including tapping, drilling, M.S strap, PP saddle, etc. including corporation cock for disconnection complete in all respects as per drawings.	No.

10.15.2.3 Pipe Fittings and Specials

10.15.2.3(a) Method of Measurement

Measurement will be made for the number of pounds of fittings and specials acceptably provided & installed in Asbestos Cement pipe work complete in all respects as per relevant drawings or as directed by the Engineer.

10.15.2.3(b) Basis of Payment

Payment will be made for the number of pounds of fittings/specials as provided above at the Contract Unit Price and shall constitute full compensation for the cost of providing, handling, fixing, jointing, disinfecting, respective type of fitting/special, and all other work related to the item.

Description	Unit
Provide & install plain ended cast iron fittings	Lbs.
Provide & install flanged cast iron fittings	Lbs.

10.15.2.4 Sluice (Gate)/Check Valves

10.15.2.4(a) Method of Measurement

Measurement will be made for the number of sluice (gate) valves or check valves acceptably provided & installed complete in all respects as per relevant Drawings or as directed by Engineer.

10.15.2.4(b) Basis of Payment

Payment will be made for the number of sluice (gate) or check valves measured as above at the Contract Unit Price for each unit and shall constitute full compensation for providing, handling, fixing and jointing and all other work related to the item including construction of chamber.

Description	**Unit**
Provide & install sluice (gate) valve including all fittings as per drawings	No.
Provide & install sluice (gate) valve including all fittings and construction of chamber as per drawings:	No.
Provide & install check valve including all fittings as per drawings	No.
Provide & install check valve including all fittings and construction of chamber as per drawings:	No.

10.15.2.5 Fire Hydrants

10.15.2.5(a) Method of Measurement

Measurement shall be made for the number of fire hydrants acceptably provided & installed complete in all respects as per relevant Drawings or as directed by the Engineer.

10.15.2.5(b) Basis of Payment

Payment will be made for the number of fire hydrants measured as above at the Contract Unit Price for each unit and shall constitute full compensation for providing, handling, fixing and jointing and all other work related to the item including construction of chamber.

Description	**Unit**

Provide and install fire hydrant including all fittings and construction of chamber as per drawings.	No.

10.15.2.6 Indication Plates

10.15.2.6(a) Method of Measurement

Measurement will be made for the number of indication plates acceptably provided & installed complete in all respects as per relevant drawings.

10.15.2.6(b) Basis of Payment

Payment will be made for the number of indication plates measured as above at the contract unit price for each unit and shall constitute full compensation for providing handling, fixing and all other work related to the item.

Description	**Unit**
Provide and install indication plates as per drawing.	No.

10.15.2.7 Washouts

10.15.2.7(a) Method of Measurement

Measurement will be made for the number of washouts acceptably provided & installed complete in all respects and as approved by the Engineer.

10.15.2.7(b) Basis of Payment

Payment will be made for the number of washouts measured as above at the contract unit price for each unit and shall constitute full compensation for providing, handling, fixing and all other work related to the item including construction of chamber.

Description	**Unit**
Provide & install washouts with all fittings for draining out the lines including construction of chamber for washout alongwith separate chamber for disposal into nearest	

manholes as shown on the drawing or as directed by Engineer.	No.

10.15.2.8 Air Valves

10.15.2.8(a) Method of Measurement

Measurement will be made for the number of air valves acceptably provided & installed complete in all respects and as approved by the Engineer.

10.15.2.8(b) Basis of Payment

Payment will be made for the number of air valves measured as above at the contract unit price for each unit and shall constitute full compensation for providing handling, fixing and jointing related to the item including construction of chamber.

Description	**Unit**
Provide install test and commission single acting air valve and all fittings including construction of chamber complete in all respects.	No.
Provide install test and commission double acting air valve and all fittings	No.

10.15.2.9 Sand Cushion

Sand filling shall be provided in excavated trenches at road crossing. Method of filling shall be same as for backfilling in trenches.

10.15.2.9(a) Method of Measurement

Measurement will be made for the number of cubic feet of sand acceptably provided & placed under road crossing complete in all respects and as approved by the Engineer.

10.15.2.9(b) Basis of Payment

Payment shall be made for the number of cubic foot of sand measured as provided above at the contract unit price per cu.ft and shall constitute full compensation for all work related to the item.

Description	**Unit**
Sand filling in trenches for pipe.	Cft.

SECTION - 11

SEWER PIPE LAYING AND APPURTENANCES

11.1 SANITARY SEWERAGE

11.2 SCOPE

The work covered by this section of the specifications consists of furnishing all reinforced concrete pipes, plant, labour, equipment, appliances and materials and of performing all operations required for installing and testing the sewer pipes in strict accordance with the specifications of this section and the applicable drawings and subject to the terms and conditions of the contract.

11.3 MATERIALS

All materials used in the manufacture of reinforced cement concrete pipes for use under this contract shall conform ASTM Designation C-76-91 or latest revision and also with the following specifications.

11.3.1 Cement

The sulphate resistant cement to be used in the manufacture of reinforced concrete pipes shall conform to the requirement of ASTM's relevant Designation C 150 (latest revision).

11.3.2 Aggregates

The coarse/fine aggregate to be used in the manufacture of concrete pipes to be furnished and installed under this contract shall be generally in accordance with the provisions of section of these specifications.

11.3.3 Water

Water to be used in the manufacture of pipes shall be approved by the Engineer.

11.3.4 Steel Reinforcement

The material shall conform to the specifications contained in Section 2 of these specifications.

11.3.5 Brick Ballast

Brick ballast shall have a maximum gauge of 1-1/2 inch and shall be graded down to 3/4 inch and shall not contain more than 10% which will pass through screen made of 1/4 in. diameter bars spaced at 3/4 in. centre to centre.

11.4 CLASSES OF PIPE

The reinforced cement concrete pipes to be furnished and installed under this contract shall be of the strength Class III Wall “B” or specified otherwise on the Drawings.

Following technical criteria shall be adhered to:

Class of Pipe : Class III Wall “B”
Concrete Strength : 4000 Psi (Cylinder Test)

The design requirements for these classes of reinforced cement concrete pipes shall be as described in ASTM Designation C-76 for the respective strength classes. Unless otherwise called for in other parts of these Technical Specifications or applicable variation order, all reinforced cement concrete pipes under this contract shall comply with the Wall B design requirements as set forth ASTM Designation C-76-91 or latest revision.

Pipe less than 12" diameter shall confirm to B.S. 5911: Part I: 1981, Class "L".

11.5 BASIS OF ACCEPTANCE

Acceptance of reinforced cement concrete pipes will be on the basis of three edge bearing and material tests as per ASTM Designation C-76-91 or latest revision and inspection of manufactured pipes for defects and imperfections. The Contractor shall bear the cost of such tests and pay fees etc., and also pay for the carriage of such samples and all other expenses contingent to tests.

11.6 PIPE DIMENSIONS

The internal diameters and wall thicknesses of reinforced concrete pipes under this contract shall be as set forth in ASTM Designation C-76-91 or latest revision in Tables 1 to 5 for "Wall B" pipes as required and shown on the Drawings.

The lengths of reinforced concrete pipes under this contract shall be as required to provide the designated laying length plus any overlap needed for the pipe joint. Pipe shall be of standard length of 8 ft. unless otherwise approved in writing by the Engineer. Only one laying length shall be permitted for each size of reinforced concrete pipe under this contract and pipes not of the approved uniform laying length shall not be used in the work. Each layer of circumferential reinforcement shall be assembled into a rigid case supported by 4 Nos. longitudinal bar of quarter inch diameter.

The strength test requirements in pounds per linear foot of pipe under the three-edge-bearing method shall be either the D-Load (test load expressed in pounds per linear foot per foot of diameter) to produce 0.01 in crack, or D-loads

to produce the 0.01 in crack and the ultimate load as specified below, multiplied by the internal diameter of the pipe in ft.

D-Load to produce a 0.01 in crack = 1000 pounds D-
Load to produce the ultimate load = 1500 pounds

Lift holes in the walls of reinforced cement concrete pipes will not be permitted under this contract for the purpose of handling and laying. Other approved lifting methods shall be employed.

11.7 CERTIFIED DRAWINGS AND DATA SHEETS

The Contractor shall submit in triplicate, for approval by the Engineer certified drawings and data sheets as required to provide complete information on all concrete sewer pipes, dimensions, type and dimensions of pipe ends, joint details, proposed concrete design mix for each different strength class of reinforced pipe and any other information needed to demonstrate full compliance with these specifications.

No concrete sewer pipe shall be delivered to the work site until the Engineer has formally approved the certified drawings and data sheets and until all test requirements called for in the respective ASTM Standard Specifications C-76 or latest revision have been met.

11.8 JOINTS FOR CONCRETE PIPE SEWERS

Rubber gasket joints shall be used for either tongue and groove or bell and spigot pipes.

Rubber gasket joints shall be made using specially designed rubber gaskets, made to fit the applicable tongue and groove or bell and spigot pipes and adequately tested under operating conditions. Special care must be taken in the selection and handling of the concrete pipes for use with rubber gasket joints, to ensure that pipe ends shall be smooth and concentric with tolerance which closely conforms to the requirements of the manufacturer of the rubber gaskets. The tongue or spigot end of each pipe shall be specially designed to perform groove or offsets to fit the manufacturer's rubber gaskets design.

The rubber gasket joints shall conform to all applicable requirements of the latest revision of ASTM Designation C443, entitled "Joints for Circular Concrete Sewer and Culvert pipe, using Flexible Watertight Rubber Type Gaskets" except that the test pressure need not exceed 10 feet of head at which the complete sewers shall meet the infiltration or ex-filtration limits set forth hereinafter.

The groove end of tongue and groove of pipes shall have at least one line of wire reinforcement of 8 gauge size placed in the centre of the groove.

The rubber gasket shall be installed on the pipe in accordance with the instructions of the gasket manufacturer. In general the gaskets shall be pre-assembled to the pipe at the pipe manufacturing plant. The pipes shall be handled with special care at all times to prevent damage to the pipe ends. A lubricant shall be used for jointing the pipes as recommended by the rubber gasket manufacturer. Care shall be taken to avoid contamination of the gasket and lubricated surfaces with earth or other undesirable material during installation.

For either tongue and groove or bell and spigot pipes, mechanical means shall be used to pull the pipe home for all sizes of 12" or larger diameter in accordance with the recommendations of the rubber gasket manufacturer. Pipes of 8"/9" diameter may be coupled manually using a cross member and bar. Under no circumstances will bars alone be used nor shall any motor driven equipment be used to force the pipe home.

11.9 HOUSE CONNECTIONS

House Connections shall be made through manholes as indicated in the drawings or as directed by the Engineer.

House connection shall be provided individually for each plot by means of a 9" dia R.C.C. sewer pipe and a dead end, laid at an average depth of 2.0 feet below N.S.L. level and in such a manner that other services such as water supply, telephone and gas lines are not disturbed or interfered. The work of laying the sewer pipe shall conform to the specifications laid down in the relevant section of this contract.

The inlet of each house connection shall be plugged with brick masonry 4 1/2 inch thick in 1:6 cement sand mortar both in the manhole and the pipe in the plot.

11.10 GULLY GRATING

Gully grating shall be made through manholes as indicated in the drawings or as directed by the Engineer.

Gully grating shall be provided on the road junctions as mentioned in the drawings by means of a 9" dia RCC sewer pipe connecting the nearest manhole with the chamber of size 1'-0"x1'-0". The pipe is laid in such a manner that other services such as water supply and sewerage system are not disturbed or interfered. The work of laying RCC pipe shall conform to the specifications laid down in the relevant section of this contract. Approved grating shall be fixed at the top.

11.11 INSTALLATION

11.11.1 Handling of Pipes

Concrete sewer pipes shall be handled with special care at all times during the manufacture, while transporting to the site of work, and while installing. Each pipe shall be carefully inspected before being laid and no cracked, broken or defective pipe shall be used in the work. Chipping of the tongue and groove or bell and spigot pipe ends, which in the Engineer's opinion may cause defective joints, shall be sufficient cause for the rejection of any concrete pipe.

11.11.2 Excavation and Backfill

The excavation and backfill for sewer installations shall be as specified in applicable provisions of these technical specifications and will be paid for under separate contract items as classified and as per applicable variation orders.

11.11.3 Placing of Bedding

11.11.3.1 Brick Ballast Bedding

The brick ballast shall be clean material of 1 to 1 1/2 inch gauge broken from first class bricks or bats, or from dense over burnt bricks. No under-burnt bricks or bats nor those which have become spongy or porous in the process of burning shall be broken up for brick ballast.

The material shall be evenly spread over the full width of the formation in 4 inches loose layers and compacted with hand or mechanical hammers until the full thickness as shown on the drawings for the particular pipe size has been built up and finished not more than 1/2" below required level. The Contractor shall note that it is essential that the material at the sides of the pipes is adequately compacted. Before the subsequent placing of pipe surrounding material, pipe joints shall be protected. Protection may take the form of a twist of yarn lightly pressed into the annular joints space or other equal protection approved by the Engineer's Representative.

11.11.3.2 Crushed Stone Bedding

Crushed stone bedding shall be from an approved source. It shall be strong, durable, hard and impervious, having crystalline structure. The broken stone shall have sharp edges and clear fractured faces, shall be free from thin elongated or laminated pieces.

The crushed stone shall have a maximum gauge of 1 1/2" and shall be graded down to 3/4". When shifted through a screen made of 1/4" diameter bars spaced 3/4" center to center, it shall yield no more than 10 percent by volume of fine materials.

11.11.4 Laying of Sewers

Neither any sewer pipe nor the bedding shall be laid or placed till the alignment of the sewer and its levels and gradients have been carefully checked and tested with the trench excavation and found correct.

Each length of sewer pipe shall be checked for cracks and defects before placing in the line. Defects which in the opinion of the Engineer indicate imperfect placing, shall make, the pipe liable to rejection. Each pipe shall be placed carefully to line and grade and in close contact with adjoining pipe. These specifications require rejection of the work if the sewer invert varies as much 1/2 inch from the proper elevation. As shown on Drawings, the bottom of the trench must be shaped to fit the pipe barrel, with holes left for the bells. If excavation has been carried below the correct grade, refilling must be done with satisfactory materials as approved by the Engineer at no extra cost. The concrete pipe joints shall be of the type specified above and shall be made in accordance with the aforesaid specifications.

When laying is not in progress, the open pipe shall be closed with a tapered wooden plug to keep out foreign matter.

11.12 TESTING OF SEWER LINES

11.12.1 General

All sewer built under this contract shall be tested for infiltration or ex-filtration as specified below. The tests shall be made at times selected or approved by the Engineer. Sections of the completed sewer shall be isolated and measurements of the infiltration or ex-filtration shall be made by approved method. The contractor shall furnish all labour, material and equipment required for making the tests with no extra compensation over and above the agreed contract prices for the laying of sewer lines.

11.12.2 Infiltration Tests

The sewers which are constructed with the ground water level above the invert level of the pipe shall be tested for infiltration after the sewers have been installed and backfilling has been substantially completed. The tests and measurement shall be performed by the Contractor in the presence of and in a manner approved by the Engineer. The duration of the tests shall be only long enough to establish the true rate of infiltration. The amount of leakage over a 24 hour period will then be calculated from the result of the measured true rate of infiltration.

11.12.3 Ex-filtration Tests

The sewers which are constructed with the ground water level below the invert

level of the pipe shall be tested for ex-filtration by isolating a section of sewers between manholes by means of approved temporary type of water tight bulk heads. The method of testing for ex-filtration shall be generally as follows:

1. After isolation of sewer section, it shall be filled with water to a level which is 3' above the crown of the pipe at the higher end of the isolated section under test. The level will not be more than 6 ft. above the invert level of the sewer pipe at its lower end.

2. The duration of the ex-filtration test shall be one hour after the filling with water has been completed.

3. Determination of the amount of ex-filtration shall be made by measuring the total loss of volume of water in the manholes.

4. The amount of ex-filtration over a 24 hour period will then be calculated from the measured loss of volume during the test observation period.

11.12.4 Allowable Infiltration or Ex-filtration

The calculated amount of infiltration or ex-filtration over a 24 hour period shall not exceed 500 gallons per inch of pipe diameter per mile of sewer which rate shall be applied to the actual sewer size and length tested to determine the allowable infiltration or ex-filtration over the 24 hour period.

If the measured infiltration or ex-filtration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs so as to reduce the leakage to less than the permissible maximum stated above.

11.12.5 Cleaning of Sewer Lines

The contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Owner.

11.13 MEASUREMENT AND PAYMENTS

Measurement and payment for sanitary sewers will be made in accordance with the provisions given hereafter.

11.13.1 Bedding

11.13.1.1 Method of Measurement

The quantity to be paid for under this item will be the number of cubic foot of bedding material acceptably provided & placed under sewers complete in all respects as per relevant drawings.

11.13.1.2 Basis of Payment

Payment shall be made for the number of cubic feet of bedding material measured as provided above at the Contract Unit Price per cubic foot and shall constitute full compensation for all work related to the item.

D e s c r i p t i o n	**Unit**
Provide & place bedding as per drawing.	Cft.

11.13.2 Sewers

11.13.2.1 Method of Measurement

Measurement shall be made at site of the actual lengths of reinforced concrete pipes of different sizes and strength supply, installed and tested, as authorized for payment under this contract. The measurement will be made along the centre line of the pipe and between the inside walls of manholes or junction chambers. The unit of measurement will be linear foot.

11.13.2.2 Basis of Payment

The unit rate quoted in the priced B.O.Q. for supplying, laying and joining cement concrete sewerage pipes shall include full compensation for the cost of pipes, charges for their carriage to site and testing before and after laying, labour charges for laying, jointing, cleaning of sewer lines etc. and cost of all incidentals for completion of this item of work as per specifications laid down in this section.

D e s c r i p t i o n	**Unit**
Supply, lay, joint and test R.C.C pipes of various sizes complete in all respects as specified in drawing.	Lft.

11.13.3 House Connections

11.13.3.1 Method of Measurement

Measurement shall be made for the number of units of house connections

provided & installed at site as per specifications & drawings complete in all respects.

11.13.3.2 Basis of Payments

Payment will be made for the number of units of House connections as measured above at the contract unit price for each unit and will constitute full compensation for supply, lay and joint 6"/9" dia R.C.C. Pipe for house connection including all excavation, backfilling, testing and all other works related to complete the item in accordance with lines and grades as shown in the drawings or as directed by the Engineer.

D e s c r i p t i o n	**Unit**
Provide and construct chamber for house connection including excavation, bedding, sand filling, backfilling including 9" dia RCC pipe complete in all respects.	No.
Provide and construct chamber for house connection including excavation, bedding, sand filling, backfilling including 9" dia RCC pipe complete in all respects.	No.

11.13.4 Gully Grating

11.13.4.1 Method of Measurement

Measurement shall be made for the number of units of gully grating provided & installed at site as per drawings complete in all respects.

11.13.4.2 Basis of Payments

Payment will be made for the number of units of Gully grating measured as above at the contract unit prices and will constitute full compensation for supply, lay and joint 6"/ 9" dia RCC Pipe for gully grating including all excavation, backfilling, testing and all other works related to complete the item in accordance with lines and grades as shown in the drawings or as directed by the Engineer.

D e s c r i p t i o n	**Unit**
Construction of chamber with grating and 9" dia RCC pipe complete in all respects as	

per drawings or as directed
by the Engineer. No.

SECTION - 12

CONSTRUCTION OF MANHOLES

12.1 SCOPE

The work consists of constructing manholes for sewerage at positions shown on the plans or where otherwise directed by the Engineer, and in accordance with the Detailed Drawings supplied from time to time, complete in all respects. The Contractor shall furnish all plant, labour equipment and materials in performing all operations in connection with the construction of manholes.

The various items of work involved in the construction of manholes shall be carried out strictly in accordance with respective technical specifications laid down for the item of work in these tender documents.

12.2 MATERIALS

Brick masonry, Portland cement concrete, and other materials shall meet the specified requirements of the relevant sections of the specifications. Cast iron frame shall conform to the specifications as per BS 497. Manhole steps shall be of galvanized mild steel.

12.3 CONSTRUCTION REQUIREMENTS

Manholes shall be constructed with brick masonry laid in 1:3 cement sand mortar, built on Class D concrete (1000 psi). The cover slab shall be of Class B (3000 psi) reinforced cement concrete, fitted with cast iron frame which shall have reinforced cement concrete cover as shown in the plans. Reinforcement and concrete shall conform to the requirements of Section "CONCRETE". The outside and inside of the walls shall be plastered (1/2 inch thick) with 1:3 cement sand mortar and two coats of hot PB-4 bitumen shall be applied outside. At the bottom of manholes for sewers, a proper channel as per Drawings, shall be constructed in the whole length of the manhole along the centre line of the sewers, to lead the sewage from one sewer to the other. Galvanized mild steel steps shall be installed at 12 inches interval inside the manhole during the construction of the manhole walls. Cutting holes into the wall for the steps after construction will not be permitted. Top rung shall be 18 inches below the manhole cover and the lowest not more than 12 inches above the benching (floor).

Depth of manhole shall be from invert level of sewer to the top of manhole.

12.3.1 Drop Manhole

The Contractor shall construct drop manholes wherever shown in the drawings or ordered by Engineer's representative. The Contractor shall make the drop connection as shown on the drawings or ordered by the Engineer's Representative.

12.4 MEASUREMENT AND PAYMENT

12.4.1 Material

Measurement and payment for various types of Manholes shall be made in accordance with the provision of this Clause specified hereafter.

12.4.1.1 Method of Measurement

Measurement shall be made for the number of manholes of various types constructed at site as per Drawings and Specifications laid down in this section and to the approval of the Engineer.

12.4.1.2 Basis of Payment

Payment shall be made for each manhole as a complete unit at the Contract Unit Price to provide and construct manhole including excavation and backfilling, covers with frame, cast iron steps, plastering, benching and all incidentals related to the item in accordance with lines and grades as shown in the Drawings or as directed by the Engineer.

D e s c r i p t i o n	**Unit**
Construction of circular masonry Manhole including manhole cover and frame.	No.
Extra over 12.1 for Drop Manholes including C.I pipes and fittings, concreting complete in all respects.	No.

SECTION - 16

MISCELLANEOUS

16.1 SCOPE

The work covered by this section of the specifications consists of furnishing all plants, labour, equipment and materials and of performing all operations in connection with the miscellaneous items in strict accordance with this section of the specifications and the applicable drawings or as directed by the Engineer.

16.2 MATERIALS AND CONSTRUCTION

16.2.1 Steel Work

Structural steel work shall comply in all respects with B.S. 449. Steel for rolled sections shall comply in all respects with B.S. 16. Welding of steel work shall comply with B.S. 1856. High strength bolted connection shall comply with B.S. 3294.

16.2.2 Steel Ladder/Stairs

Steel access ladders shall comply with B.S 4211 unless otherwise stated. Stringers shall be rectangular section measuring 2-1/2 inches by 1/2 inches spaced 15 inches apart and rungs shall be 3/4 inch diameter spaced at 12 inches centre. Hoops shall be of circular pattern and shall be bolted to the stringers so as to be removable. Ladders shall be painted with black enamel paint of an approved make.

Steel stairs shall be as shown on the Drawings or as directed by the Engineer.

16.2.3 Brick Pavement

Bricks for pavement in the water works areas shall comply with the requirements of Section-3 of the technical specifications. Excavation and compacted backfill shall be in accordance with the requirements of Section-1 of the Technical Specifications. Bricks joints shall be sand grouted. Pavement shall be constructed in accordance with the Drawings or as directed by the Engineer.

16.2.4 Level Indicator

Level indicators shall be installed in accordance with the applicable drawings and as directed by the Engineer. The contractor shall be responsible for manufacturing and fixing of all components involved to make it a complete working unit.

16.2.5 Lightening Arrester

Lightening Arrester including all associated copper strip shall be installed strictly in accordance with the applicable drawings and as directed by the Engineer. The Contractor shall be responsible for providing and fixing all copper strips and other components to make it a complete working unit.

16.2.6 Disinfection of Overhead Water Tanks

All water tanks shall be disinfected with the application of 50 ppm. dose of chlorine solution in accordance with the procedure specified by the Engineer.

16.2.7 Rungs

Malleable cast iron rungs of sizes as shown on the Drawings shall be provided.

16.2.8 Manhole Cover

(a) Manhole covers and frames shall be of Mild Steel. The frame shall be firmly embedded in Class B concrete, as shown in drawing.
(b) Manhole covers shall be of concrete class `A' with reinforcement and frame as shown in the drawing.

16.2.9 Vents

Vents shall be of cast iron and shall conform to the requirement of the Section-10. The Contractor shall supply and install vents of type as shown on the Drawing or as directed by the Engineer for circulation of air through tanks after the roofs have been completed. Vents shall be fitted with cowl or wire mesh balloon.

16.2.10 Service Ducts

Contractor shall provide and lay underground concrete service duct of the type and at the location as shown on the drawing, or as directed by the Engineer, for the crossing of the service lines. The work shall include excavation of the trench, laying of duct and backfilling.

The open ends of the duct shall be properly plugged to avoid blocking of the duct.

16.2.11 (a) Bar Screen

Contractor shall provide and fix Bar Screen at the location as shown on the drawing, or as directed by the Engineer. The screen shall be fixed with concrete and painted. The work shall include fixing of the Bar Screen in the concrete and painting the bars.

(b) Galvanized Mild Steel Grating

Contractor shall provide and fix galvanized mild steel grating at the location as shown on the drawing, or as directed by the Engineer. The grating shall be flush with concrete and painted. The work shall include fixing of grating and painting the bars.

16.2.12 Toilet Fixtures and Plumbing Works

Toilet fixtures and plumbing works as approved by the Engineer shall be fixed according to standard drawings. The Contractor shall be responsible for proper fixing of the plumbing works strictly in accordance with engineering practice. This work include complete items to make the system functional.

16.2.13 Exhaust Fans

Contractor shall provide and fix Electric Fan of the approved make and brand. The fan shall be properly fixed including all necessary accessories. The work shall include fixing and making the working functional.

16.2.14 Operator's Quarter

(a) **General**

The work shall consist of furnishing all plant, labour equipment, appliances and materials and in performing all operations in connection with construction of Operator's quarter including plumbing and internal electrification in accordance with these specifications and in reasonably close conformity with the lines, grades and dimensions shown in the drawings or directed by the Engineer.

(b) **Material**

Building for Operator's quarter, fences and gates shall be construction in accordance with the relevant specifications and Drawings or as directed by the Engineer.

16.2.15 Septic Tank

The work shall consist of furnishing all plant, labour equipment, appliances and materials and in performing all operations in connection with construction of Septic Tank including excavation, brick/block work, plastering, concreting, inlet and outlet pipes, manhole covers etc. in accordance with these specifications in the relevant sections and in reasonably close conformity with the lines, grades and dimensions shown in the drawings or directed by the Engineer.

16.2.16 Penstock Gate

The work shall consist of providing and fixing of penstock gate in the screening chamber of sewage pumping station. The penstock shall be of cast iron and shall be fixed in such a way that its gate operates without hinderance and when in closed position completely blocks the flow.

16.3 MEASUREMENT AND PAYMENT

16.3.1 Miscellaneous Items

Measurement and payment for miscellaneous items will be made in accordance with the provisions of this clause specified hereinafter.

16.3.1.1 Method of Measurement

Rolled Section Steel will be measured by the length in linear ft. for the work satisfactorily completed as shown in the Drawings or as directed by the Engineer.

Steel ladder/stairs will be measured by the length in linear ft. for the work satisfactorily completed as shown on the Drawings or as directed by the Engineer.

Brick Pavement will be measured by the area in square foot for the work satisfactorily completed as shown on the Drawings or as directed by the Engineer.

Level indicators shall be measured by the number for the work satisfactorily completed as shown on the Drawings or as directed by the Engineer.

Lightening Arrester shall be measured by the number for the work satisfactorily completed as shown on the Drawings or as directed by the Engineer.

Disinfection of overhead water tanks will be measured by the number for the work satisfactorily completed as shown on the Drawings or as directed by the Engineer.

Malleable cast iron rungs shall be measured by the number for the work satisfactorily provided & laid as shown on the drawing or as directed by the Engineer.

Manhole covers shall be measured by the number for the work satisfactorily completed as shown on the Drawings or as directed by the Engineer.

Air vents shall be measured by the number for the work satisfactorily completed as shown on the Drawings or as directed by the Engineer.

Concrete service ducts shall be measured by the number of linear foot of duct satisfactorily provided & laid as shown on the drawing or as directed by the Engineer.

Mild steel bar screen and galvanized mild steel grating shall be measured by the area in the square ft. for the work satisfactorily provided & installed as shown on the drawings or as directed by the Engineer.

No measurement for fixtures along with plumbing works will be made. Lump sum will be the basis for payment.

Measurement will be made for each item of fan and accessories all acceptably supplied and installed by the contractor as a complete unit.

Septic Tank along with items as shown in the drawing shall be measured by the number for the work satisfactorily completed as directed by the Engineer.

Penstock gate alongwith complete assembly and fixation as shown in the drawing shall be measured by the number for the work satisfactorily completed as shown on the drawing or as directed by the Engineer.

16.3.1.2 Basis of Payment

Payment will be made in accordance with the unit prices in the Bill of Quantities of the various items in accordance with the specifications and shall constitute full compensation for furnishing all materials, equipment and labour and for performing all operations necessary to complete the work.

Description	Unit
Provide, fix and paint rolled steel section.	Lft.
Provide and fix C.I. ladder including painting as per drawings and specifications.	Lft.
Provide and lay brick pavement as shown on drawings or as directed by the Engineer.	Sft.

Provide and fix level indicator complete in all respects as per drawings and specifications or as directed by the Engineer.	No.
Provide and fix lightening arrester, copper earth strips and all other accessories complete in all respects as per drawings or as approved by the Engineer.	No.
Clean, test and disinfect overhead water tank.	No.
Provide and fix malleable cast iron rungs as shown on drawings or as directed by the Engineer.	No.
Provide and fix Manhole covers of sizes as shown on drawings or as directed by the Engineer.	No.
Provide and fix 4" dia Air vent on roof of over head tank as per drawings or as directed by the Engineer.	No.
Provide and lay underground concrete service ducts of types as shown on the drawings or as directed by the Engineer.	Lft.
Provide and fix mild steel screen bar and galvanized mild steel grating as shown on the drawings.	Sft.
Provide and fix all toilet fixtures along with plumbing works complete with all accessories fittings, manhole chambers, gully traps, as shown in drawings or as directed by the Engineer	Lump sum
Provide and install exhaust fans accessories.	No.
Construction of Control Room, Generator	

Room complete in all respects as per drawings and specifications.	Item wise BOQ Provided
Construction of septic tank complete in all respects as per drawings and specifications.	No.
Provide and install penstock gate on screening chamber as shown on the drawing or as directed by the Engineer	No.

SECTION - 21

STRUCTURAL EXCAVATION AND BACKFILL

21.1 SCOPE

Structural excavation shall consists of excavation in earth or rock with in the limits of the work as specified herein or as shown in the drawings or as directed by the Engineer, and shall include the removal of all material, of whatever nature, necessary for the construction of foundations of R.C.C. culverts, pipe drainage, open/covered drains, manholes, inlets and other structures not otherwise provided for in these specifications and in accordance with the plans or as directed by the Engineer. It shall include the furnishing of all necessary equipment and formwork shoring etc., which may be necessary for the execution of the work. It shall also include the subsequent removal of formwork and the placement of all necessary backfill as hereinafter specified. It shall also include the disposing off excavated material, which is not required for backfill, in a manner and at locations so as not to affect the carrying capacity of any channel/drain or as directed by engineer.

21.2 MATERIAL REQUIREMENTS

21.2.1 Backfill

Backfill shall consist of granular material or other common materials as noted on the drawings or as approved by the Engineer.

21.3 CONSTRUCTION REQUIREMENTS

21.3.1 General

Structural Excavation shall be limited to the excavation for culverts, retaining walls, head walls, wing walls, catch basins, manholes, inlets and other structures not otherwise provided for in these specifications for the whole or part of the structure, according to its measurement as defined in clause 21.1. The price of structural excavation shall include backfilling, (except when granular backfill as specified in clause 21.4.1 is ordered in writing by the Engineer), to these structures with material approved of by the Engineer, disposing off surplus material, all necessary draining, pumping, bailing, sheeting, shoring, the construction of cribs and cofferdams and their subsequent removal, and the removal of existing structures or parts thereof which obtrude or encroach upon the structural excavation. Backfilling behind walls or box structures (culverts, underpass, etc.) shall be placed simultaneously on both side of the structures.

During the progress of excavation the Engineer will examine the nature of material taken out and shall have authority to stop the excavation for bearing tests at contractor's cost. The Engineer may require the contractor to excavate below the elevations shown on the drawings, depending upon where suitable foundation material is encountered.

21.3.2 Drain Excavation

Drainage excavation means excavation required for installation or salvation of pipe culverts, pipe siphons, pipe drains and sewers or excavation required in the shape of slopes or ditches to form inlet basins to culverts and in construction of miscellaneous structures specifically mentioned on drawings or ordered by the Engineer or excavation required in construction of inlet ditches, outlet ditches, drain ditches, canals, Channel changes, and other ditches.

Trenches shall be of sufficient width to enable the pipe to be properly laid and joined. The Contractor shall keep the trenches and other excavation quite free from water, so that works may be constructed in dry conditions. All backfilling shall consist of approved excavated material deposited in layer not to exceed 8 inches in depth and rammed to reach a specified compaction standard of 95% of maximum dry density according to AASHTO T-180 Method D.

21.3.3 Preservation of Channel/Drain

Unless otherwise specified, no excavation shall be made outside of formwork and the natural stream bed adjacent to the structure shall not be disturbed without permission from the Engineer. If any excavation or dredging is made at the site of structure before formwork is in place, the Contractor shall, without extra charge, after the foundation base is in place, backfill all such excavation to the original ground surface or channel/drain bed with material satisfactory to the Engineer. Material deposited within the stream area from foundation or other excavation shall be removed and the stream bed freed from obstruction thereby.

21.3.4 Depth of Footings

The elevations of the bottom of footings, as shown on the drawings, shall be considered as approximate only and the Engineer may order, in writing, such changes in dimensions or elevation of footings as may be necessary to secure a satisfactory foundation.

21.3.5 Preparation of Foundations for Footings

- All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, either level, stepped, or roughened, as may be directed by the Engineer.

- When masonry is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation, and the change of surface elevation shall not be made until just before the masonry is to be placed.

21.3.6 Inspection

After each excavation is completed the Contractor shall notify the Engineer, and

no masonry/concrete shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

21.4 BACKFILL MATERIALS

21.4.1 Granular Backfill

Granular backfill shall be placed in the position and to the required depth, shown on the drawings or where and as required in writing by the Engineer and it shall be well compacted in layers not exceeding 8 inches in thickness to 95% of maximum dry density according to AASHTO T-180 METHOD-D as shown on the Drawings or as specified by the Engineer.

Granular backfill material shall give the following grading requirements.

GRADING REQUIREMENT

MM	Inch	A	B
25.00	1"	100	100
19.00	3/4"	60-100	75-100
4.75	No.4	50-85	55-100
2.00	No.10	40-70	40-100
0.425	No.40	25-45	20-50
0.075	No.200	10-26	6-20

or material satisfying the requirements of coarse sand falling under soil classification A-3. In case, course sand is utilized for granular fill it shall be ensured that the same is confined properly with approved material.

21.4.2 Common Backfill

Common backfill shall consist of earth free from large lumps, wood and other organic materials and of a quality acceptable to the Engineer. It shall be placed in the position and to the required depths shown on the Drawings and/or as required in writing by the Engineer and it shall be well compacted in layers not to exceed 8 inches in depth to the density shown on the drawings or as specified by the Engineer.

21.4.3 Special Backfill

This work shall consist of selected material as defined hereinafter, furnished, placed and compacted in layers against the inside faces of abutments and over the extrados of arches, in accordance with these specifications and in conformity with the requirements shown on the plans. Selected material for special backfill may be either gravel, brick, crushed brick or stones or sand. Gravel crushed brick and crushed stones shall consist of sound durable, particles, all of which shall be retained on a No.4 sieve as determined by ASSHTO T-27. Any material not suitable for water percolation shall not be used.

Fill placed around structures shall be deposited on both sides to approximately the same elevation at the same time. Adequate provision shall be made for the thorough drainage of all backfill.

No backfill shall be placed against any masonry/concrete foundation or culvert until permissions have been given by the Engineer and preferably not until the masonry/concrete has been in place for fourteen (14) days, or until test cylinders show the strength to be twice the working stress used in the design.

21.5 MEASUREMENT AND PAYMENT

21.5.1 Method of Measurement

The quantities of structural excavation to be paid for shall be the number of 100 cubic feet of material measured in its original position computed by the average end-area method, and structural excavation to the satisfaction of the Engineer.

Structural Excavation will be classified as "Structural Excavation in Rock" or as "Structural Excavation in Common Material", according to the excavation in rock or earth as defined in Section-19.3, and shall be paid under respective items for measurement and payment.

The volume of earth or rock to be measured for structural excavation shall consist of a prismoid bounded by the following planes:

- The vertical limits for computing pay quantities are as shown on the Drawings.

- The upper limit for payment of structural excavation shall be the ground surface as it existed prior to the start of construction operations, except where structural excavation is performed within roadway excavation or ditch excavation areas the upper limit shall be the planes of the bottom and side slopes of said excavated areas.

- The lower limits for computing pay quantities of structural excavation or structural backfill shall be a plane at the bottom of the completed footings, foundations or structures.

Measurement for structural excavation shall not include material removed below the footing grade and beyond specific limits to compensate for anticipated swell or as a result of effective swell resulting from slides, slips, cave-ins, silting or fillings, whether due to the action of the elements or to the carelessness of the Contractor. The depths of the footings shown on the drawings are approximate only and any variation found to be necessary during construction shall be paid for at the contract unit price.

a) Granular Backfill

The quantities of Granular Backfill to be paid for shall be the number of 100 cubic feet of material laid in place within the limits defined in Section-21.4 above, computed and accepted by the Engineer.

b) Common Backfill

The quantities of Common Backfill to be paid for shall be the number of 100 cubic feet of material laid in place within the limits defined in Section-21.4 above, computed by the average end-area method, compacted and accepted by the Engineer.

c) Special Backfill

The quantities of Special Backfill to be paid for shall be the number of 100 cubic feet of material laid in place within the limits defined in Section-21.4 above, computed by the average end-area method, compacted and accepted by the Engineer.

21.5.2 Basis of Payment

The quantities determined as provided above shall be paid for at the contract unit price respectively, for each of the particular pay item listed below that is shown in the Bill of Quantities, which price and payment shall be full compensation for all the costs involved in the proper completion of the work prescribed in this item.

Description	Unit of Measurement
Structural Excavation in Common Material	Cft.
Structural Excavation in Rock Material	Cft..
Granular Backfill	Cft.
Common Backfill	Cft.
Special Backfill	Cft.
Provide, place and compact Sand filling under floor	Cft.
Spreading sand @15Cft/100 Sft Over brick on edges	Sft.

SECTION - 22

REMOVAL OF EXISTING STRUCTURES

22.1 DESCRIPTION

The work specified in this Section consists of the removal and disposal of the materials from existing structures. The structures to be removed shall be: (1) those structures, or portions of structures, shown on the plans to be removed; (2) those found within the limits of the area to be cleared and grubbed, and directed by the Engineer to be removed and (3) those structures or portions or structures which, in the opinion of the Engineer, it is necessary to remove in order to construct the new structures.

22.2 REMOVAL

The structure shall be removed in such a way as to avoid damage to the materials and to leave no obstructions to any proposed new structures or to any waterways. In the case of timber structures, all bolts, nails etc., shall be entirely removed from all useable materials, as determined by the Engineer, except that nail removal will not be required from two-inch by four-inch decking unless specifically required by the plans. All piling shall be pulled or cut, or shall be broken off two feet below the finished excavated surface of the original ground surface. Structural steel members shall be marked as directed, for identification. Where a portion of the existing structure is to remain in place explosives shall not be used to remove reinforced concrete. Under ground structures and chambers shall be demolished to the depth shown on the Drawings. They shall be properly cleared out and filled with suitable material and compacted to the specified density.

The concrete bridges to be partially removed and widened, concrete shall be removed by manually or mechanically operated pavement breakers, concrete saws or chipping hammers. Wherever concrete is to be removed to neat lines the outlines of the works shall first be made with small trenches or grooves about one inch deep cut in the existing concrete surface. Care shall be taken to confine the breakage to the correct outline.

22.3 DISPOSAL

All waste materials shall be disposed of, as directed by the Engineer, within 3000 ft. haul. All useable material, as determined by the Engineer shall be stacked in neat piles within the right of way.

22.4 MEASUREMENT & PAYMENT

22.4.1 Method of Measurement

The unit of measurement for Removal of Existing Structure will be job item, for the entire area of the project designated for Removal of Existing Structures.

22.4.2 Basis of Payment

The lump sum rate shall be full compensation for all costs of complying with the provisions of this Section and includes costs of all materials, labour and machinery etc.

D e s c r i p t i o n	**Unit of Measurement**
Removal of Existing Structures	Lump sum

SECTION- 37

GRP PIPE

37.1 GRP PIPE

Glass Fiber Reinforced Plastic (GRP/FRP) Thickness: 7.68mm, Pressure Class B, 06 bar, Length: 06 or 12 meter as per ASTM standard 3754 suitable for Sewerage,
Disposal & Effluent Water made with Clear Resin with Fiberglass Reinforcements without any inclusion of silica filler. The corrosion barrier layer must be of chemical resistant Epoxy Vinyl Ester Resin like Hetron 922 or equivalent. Corrosion barriers must have minimum thickness 02mm; and structural build up by filament winding having thickness not less than 5.68mm. The pipe structure should be designed keeping in view guide lines of AWWA C950 and Manual of water supply practices M45. Winding angle of structural build up must be selected to qualify 2500STIS and high hoop & tensile strength.
The hydro testing of Pipe will be performed at double of the design pressure in the factory and 1.5 times after installation. The jointing system will be Bell & Spigot having double O-ring rubber
seals.

37.2 MEASUREMENT AND PAYMENT

37.2.1 Pipe work

Measurement and payment of pipe work, fittings, specials and appurtenances will be made in accordance with the provisions of this clause specified hereinafter.

37.2.1.1 Method of Measurement

Measurement will be made for the number of linear feet of GRP pipes acceptably provided & installed complete in all respects as per relevant Drawings and specification as directed by the Engineer.

37.2.1.2 Basis of Payment

Payment will be made for the number of linear feet of pipe work as measured above at the Contract Unit price of each unit and shall constitute full compensation to provide, handle, lay and joint GRP pipes and including flushing, leakage testing before & after backfilling, final flushing and works related to the item.

Description	Unit
Providing, laying, cutting, jointing, testing GRP pipe Class B in trenches, complete in all respects including fittings as per drawings and as directed by the Engineer In charge	Rft

SECTION-41

SWEET EARTH FILLING IN GENERAL AREAS

41.1 DESCRIPTION

The work shall consist of providing & filling sweet earth for plantation in center median green belt and other locations, and compact to degree of compaction of natural ground complete in all respects and as directed by the Engineer.

41.2 MATERIAL REQUIREMENTS

41.2.1 Sweet Soil

Sweet soil shall consist of a natural friable surface soil without admixture of undesirable subsoil, refuse, or foreign materials. It shall be reasonably free from roots hard clay, coarse gravel, stones larger than 1inch in diameter, noxious woods, tall grass, or other litter, and shall have been taken from the field where healthy growth of crops, grasses, trees or other vegetation was cultivated.

41.3 CONSTRUCTION REQUIREMENTS

41.3.1 Source of Material

The Contractor shall notify the area to the Engineer at least 7 days prior to his intentions of digging in that area and placement of soil. The operation of digging and then placement shall start only after approval of Engineer of the area and quality of soil to be placed as top soil in the designated areas as shown on the drawings and/or directed by the Engineer.

41.3.2 Placing of Sweet Soil

The soil shall be evenly spread and to the line and slope as shown on the drawings and compacted to degree of compaction of Natural ground a depth of not less than 6inches and/or as directed by the Engineer. Spreading shall not be done when the ground topsoil is excessively wet, or otherwise in a condition detrimental to the work. The roadway surfaces shall be kept dean during hauling and spreading operations.

After spreading has been completed, large clods, stones, roots, stumps and other such unwanted material if any shall be raked and removed.

41.4 MEASUREMENT AND PAYMENT

41.4.1 Measurement

The work of sweet top soi1ing shall be measured by the cubic feet, which has been placed in accordance with these specifications and accepted by Engineer.

41.4.2 Payment

The quantity 1T1easured for payment as described above: shall be at contract unit price for items listed below, and shown in Bill of Quantities. The payments shall include full compensation for furnishing all material, labor and equipment including water, transport and all cost necessary to complete the work in accordance with these specifications and accepted by Engineer.

Pay Item No.	Description	Units of Measurement
41	Supplying and filing of sweet earth for plantation in center median green belt / other location and compact to degree of compaction of natural ground complete in all respect and as directed by Engineer.	Cft