

CHAPTER 4 DRAINAGE WORKS

SECTION 4.1 MASONRY DITCH

4.1.1 Description

This item shall consist of stone-pitched channel constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Drawings or requested by the Engineer.

4.1.2 Materials

- a. Stones consist of field stone or rough unhewn quarry stone, as nearly rectangular in section as is practical.

The stone shall be sound, tough, durable, dense, resistant to the action of air and water, and suitable in all respects for the purpose intended.

Quality and dimensions of stone shall be approved by the Engineer prior to use. Unless otherwise provided by the Drawings or the Specification, the standard size of rubble stone shall be 30 cm x 30 cm x 15 cm.

- b. Prior to the work commencement, the Contractor shall submit the samples of rubble stones and cobble stones for approval.
- c. Mortar for joint sealing shall conform to the requirements of JT 1003-66 or GB [].
- d. Expansion joint shall meet the requirements of Section 4.2 of this Specification.

4.1.3 Construction Methods

4.1.3.1 UNCLASSIFIED EXCAVATION.

- a. Trenches and channels for masonry structures shall be excavated to the lines and grades or elevations shown on the Drawings. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure shown.
- b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed.

- c. The Contractor shall do all bracing, sheathing, or shoring necessary to perform and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for excavation.
- d. Unless otherwise provided, bracing, sheathing, or shoring involved therewith shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner which will not disturb or mar finished concrete. The cost of removal shall be included in the unit price bid for excavation.
- e. After each excavation is completed, the Contractor shall notify the Engineer to that effect, and stone masonry shall be placed after the Engineer has approved the depth of the excavation and the character of the foundation material.

4.1-3.2 STONE PITCHING

- a. Prior to placing stones, the foundation base upon which the stone pitching is to be built shall be prepared. A 10 cm thick gravel layer shall be laid on the foundation base shown on the Drawings.
- b. Rubble stone shall be securely placed by hand, and voids shall be avoided to the extent possible. The face surfaces of all rubble stones shall form a smooth regular surface conforming to the shape of the ditch. No rubble stone surface shall extend more than one and a half centimeters above or below the general level of the ditch.
- c. All voids between stones shall be filled flush with mortar but the face surface of the stone shall be left exposed. Mortar shall be placed from bottom to top and the surface swept with a stiff broom. The surface shall be cured for a period of at least three days.
- d. When interrupting work, spaces in the stone layers already laid must be filled completely with mortar so that the stones do not loosen or move. When laying the stone begins again, the surface of the stone layer must be cleaned properly, and the layer shall be moistened by sprinkling water.
- e. Stacking of rubble stones during each day shall not exceed a height of 1.2 m.
- f. The tolerances for mortared rubble stone shall be as stated in the following table:

Tolerances by Category for Mortar Stone Masonry Drain Ditches

Inspection Category	Tolerance (mm)
Center Line	± 20
Wall Axis	± 15
Height Near Wall Roof, Height Near Cover Roof	± 0, -20
Surface Smoothness of Wall (Measure With a 2 m Straightedge)	20
Thickness of Wall	± 20
Vertical Straightness of Sides and Vertical Straightness of Sinking Joints	20

4.1-3.3 **WEEP HOLES.** Weep (outlet) holes shall be constructed as shown on the Drawings. A 40 mm x 40 mm geo-textile shall be attached to the lower end of each weep hole shown on the Drawings.

4.1-3.4 **JOINT SEALING**

- a. Expansion joints shall be formed at a maximum spacing of 10 meters. Joints shall be 20 mm in width and shall extend through the complete wall and bottom lining. Rubble stones used for joint forming shall be selected so as to form a clean vertical joint of dimension specified above.
- b. Before sealing the joints, the wall surface shall be cleaned thoroughly to remove any mortar, soiling or debris, and the wall surface shall be moistened by sprinkling water.
- c. The form of the joints for the rubble stone masonry, and the grade of the mortar shall be as set forth in the Drawings.
- d. The mortaring for the joints must maintain the natural joining of the stone masonry. When mortaring convex joints, it shall be required that the mortar joints shall be aligned, that the corners shall be rounded and smooth, that the widths shall be uniform, and that the joints be firmly packed, and there must be no splitting or any cracks.

4.1.4 **Method of Measurement**

4.1-4.1 The quantity of unclassified excavation for masonry ditches to be paid for shall be the number of cubic meters, measured in original position, of material excavated in accordance with the Drawings, or as directed by the Engineer.

4.1-4.2 Masonry work shall be measured by the number of cubic meters of stone pitching, complete in place and accepted. In computing the volume of stone masonry for payment, the dimensions used shall be those shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for weep holes

with geo-textiles. No deductions in volume shall be made for the volumes of embedded items.

4.1-4.3 Gravel or grit stone bedding shall be measured by the number of cubic meters of materials laid, compacted in place and accepted.

4.1-4.4 Joint sealing shall be measured by the number of square meters of materials in place, completed and accepted. No measurements or other allowances shall be made for expansion joint materials.

4.1.5 Basis of Payment

4.1-5.1 Payment will be made at the Contract unit price per cubic meter for unclassified excavation for masonry ditches; at the Contract unit price per cubic meter for masonry work; and at the Contract unit price per square meter for joint sealing. These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and placing the materials, and for all labor, equipment, tools, and incidentals necessary to complete the structure.

The costs of gravel layers, geo-textiles, and weep holes will not be paid for separately but shall be included in the Contract price per cubic meter for masonry work.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-3 (Area A)		
1-1*	Excavation	cubic metre
1-2*	Masonry work	cubic metre
1-3*	Expansion joint	square metre
1-4*	Gravel (grit stone) bedding	cubic meter

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 4.2 IN-SITU CONCRETE STRUCTURES

4.2.1 Description

- 4.2-1.1 This item shall consist of reinforced structural portland cement concrete, prepared and constructed in accordance with these specifications, at the locations and of the form and dimensions shown on the Drawings.

4.2.2 Materials

- 4.2-2.1 **GENERAL.** Only approved materials, conforming to the requirements of these specifications, shall be used in the work. They may be subjected to inspection and tests at any time during the progress of their preparation or use. The source of supply of each of the materials shall be approved by the Engineer before delivery or use is started. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be scored and handled to insure the preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed therein.

In no case shall the use of pit-run or naturally mixed aggregates be permitted. Naturally mixed aggregate shall be screened and washed, and all fine and coarse aggregates shall be stored separately and kept clean. The mixing of different kinds of aggregates from different sources in one storage pile or alternating batches of different aggregates will not be permitted.

- 4.2-2.2 **STONE BEDDING MATERIALS.** Macadam stone bedding materials shall conform to the requirements of Section 3.1.1 of this Special Provision.

Crushed stone with 0-50 mm stone particles without sieving shall be used for the macadam stone bedding for all of the various types of drainage ditches with covers, box culverts and double box culverts. The Los Angeles coefficient shall be not more than 30%. The percentage by weight passing through a 5 mm sieve shall be 30% or less, and the percentage by weight passing through a 0.75 mm sieve shall be 15% or less. The solid content ratio after compacting for the macadam stone bedding shall be at least 78%. These tests shall be pursuant to JTJ 051-93.

- 4.2-2.3 **COARSE AGGREGATE.** The coarse aggregate for concrete shall meet the requirements of ASTM C 33 or JT 1003-66 or GB [].

Coarse aggregate shall be well graded from coarse to fine and shall meet one of the gradations shown in Table 1, using ASTM C 136.

4.2-2.4 **FINE AGGREGATE.** The fine aggregate for concrete shall meet the requirements of ASTM C 33.

The fine aggregate shall be well graded from fine to coarse and shall meet the requirements of Table 2, when tested in accordance with ASTM C 136 or JTJ 053-94:

TABLE 1. GRADATION FOR COARSE AGGREGATE

Sieve Designation (square openings)	Percentage by Weight Passing Sieves						
	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No.4
No. 4 to 3/4 in. (4.75-19.0 mm)	-----	-----	100	90-100	-----	20-55	0-10
No. 4 to 1 in. (4.75-25.0 mm)	-----	100	90-100	-----	25-60	-----	0-10
No. 4 to 1-1/2 in. (4.75-38.1 mm)	100	95-100	-----	35-70	-----	10-30	0-5

TABLE 2. GRADATION FOR FINE AGGREGATE

Sieve Designation (square openings)	Percentage by Weight Passing Sieves
3/8 inch (9.5 mm)	100
No. 4 (4.75 mm)	95 - 100
No. 16 (1.18 mm)	45 - 80
No. 30 (0.60 mm)	25 - 55
No. 50 (0.30 mm)	10 - 30
No. 100 (0.15 mm)	2 - 10

Blending will be permitted, if necessary, in order to meet the gradation requirements for fine aggregate. Fine aggregate deficient in the percentage of material passing the No. 50 mesh sieve may be accepted, provided that such deficiency does not exceed 5% and is remedied by the addition of pozzolanic or cementitious materials other than portland cement, as specified in 4.2-2.6 on admixtures, in sufficient quantity to produce the required workability as approved by the Engineer.

4.2-2.5 **CEMENT.** Cement shall conform to the requirements of GB 175. Portland cement shall be used for structural concrete.

The Contractor shall furnish vendors' certified test reports for each carload, or equivalent, of cement shipped to the project. The report shall be delivered to the

Engineer before permission to use the cement is granted. All such test reports shall be subject to verification by testing sample materials received for use on the project.

If for any reason, cement becomes partially set or contains lumps of caked cement, it shall be rejected. Cement salvaged from discarded or used bags shall not be used.

4.2-2.6 **WATER.** The water used in concrete shall be free from sewage, oil, acid, strong alkalis, vegetable matter, and clay and loam. If the water is of questionable quality, it shall be tested in accordance with AASHTO T 26.

4.2-2.7 **ADMIXTURES.** The use of any material added to the concrete mix shall be approved by the Engineer. Before approval of any material, the Contractor shall be required to submit the results of complete physical and chemical analyses made by an acceptable testing laboratory. Subsequent tests shall be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

Pozzolanic admixtures shall be fly ash or raw or calcined natural pozzolans meeting the requirements of ASTM C 618 or GB [].

Air-entraining admixtures shall meet the requirements of ASTM C 260 or GB []. Air-entraining admixtures shall be added at the mixer in the amount necessary to produce the specified air content.

Water-reducing, set-controlling admixtures shall meet the requirements of ASTM C 494, Type A, water-reducing or Type D, water-reducing and retarding.

Water-reducing admixtures shall be added at the mixer separately from air-entraining admixtures in accordance with the manufacturer's printed instructions.

4.2-2.8 **MORTAR.** Mortar shall consist of one part portland cement and two parts sand. The portland cement shall conform to the requirements of GB 175. The sand shall conform to the requirements of ASTM C 144 or JT 1003-66 or GB [].

4.2-2.9 **PREMOLDED JOINT FILLER.** Premolded joint filler for expansion joints shall conform to the requirements of ASTM D 1751 or GB []. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Engineer. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the Engineer.

4.2-2.10 **JOINT SEALER.** The joint sealer for the joints in the concrete pavement shall meet the requirements of GB [] and shall be of the type(s) specified in the Drawings.

a. GB [] for Polyvinyl Chloride (PVC) joint sealer

b. GB [] for Polyurethane (PUT) joint sealer

4.2-2.11 **STEEL REINFORCEMENT.** Reinforcing bars shall conform to the requirements of applicable GB standards.

a. Round bars specified as 10 mm or less
GB 1498-91 or JIS G 3112 (Grade SR 24)

b. Deformed bars specified as 10 mm or more
GB 1499-91 or JIS G 3112 (Grade SD 30)

4.2-2.12 **SLIP BARS.** Slip bars shall be round steel bars conforming to ASTM A 615 or GB 1498-91 and shall be free from burring or other deformation restricting slippage in the concrete.

4.2-2.13 **COVER MATERIALS FOR CURING.** Curing materials shall conform to one of the following specifications:

Waterproof paper for curing concrete	ASTM C 171
Polyethylene Sheeting for Curing Concrete	ASTM C 171
Liquid Membrane-Forming Compounds for Curing Concrete	ASTM C 309, Type 2

4.2.3 Construction Methods

4.2.3.1 Excavation and Foundation Preparation

a. The Contractor shall do all excavation for concrete structures to the lines and grades or elevations, shown on the plans, or as staked by the Engineer. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure foundations shown on the Drawings.

b. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All satisfactory materials shall be hauled and placed in fills, and unsuitable materials shall be placed in spoil areas or as directed by the Engineer.

c. When using equipment to excavate the drain ditches, care must be taken to ensure that no damage is caused to the soil structure for the bottom of the ditch. If it is difficult to accurately level or smooth the ditch based on the height of the bottom of the drain ditch, the equipment shall be used to excavate only to a depth that is 20 cm above the planned ditch height, and the remaining excavation must be performed manually.

- d. The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws.
- e. Unless otherwise provided, bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall be effected in a manner which will not disturb or mar finished work.
- f. After each excavation is completed, the Contractor shall notify the Engineer to that effect; and bedding materials shall be placed after the Engineer has approved the depth of the excavation and the character of the foundation material.
- g. The density for the foundation base of the drainage ditches shall be as set forth below:
 - (1) For Type II U-shaped ditches with covers, box culverts with covers and double box culverts, the compaction density for 0-15 cm below the foundation surface of the drainage channels shall be at least 93% of the maximum density as determined by JTJ 051-93. If the compaction density cannot meet this specification because of excess moisture content, quicklime of 6% should be mixed in to meet the requirements.
 - (2) For Type I and III ditches with covers, box culverts with covers, U-shaped ditches, and double box culverts, as well as wet masonry ditches, the compaction density for 0-15 cm below the foundation surface of the drainage channels shall be at least 87% the maximum density.
- g. If there is any gray silty clay in the 2-2 layer at the base layer of the bottom of the excavation, this silty clay shall be removed using the following procedures:
 - (1) For Type II U-shaped ditches with covers, box culverts with covers, and double box culverts, gray silty clay in the 2-2 layer shall be removed to the top of the clayey silt in the 2-3 layer, and shall be replaced with lime soil backfilling. The lime soil used for replacement shall be sandy soil (with plastic modules of 15-20). A lime content of 6% shall be sufficient. The work shall be performed through manual compacting or using light machinery, in several lime soil layers, so that the compaction density is at least 93% the maximum density.
 - (2) For other drainage ditches (i.e., ditches with covers, box culverts with covers, U-shaped ditches, double box culverts, and wet masonry ditches), the 2-2 layer shall be removed to the top of the gray clayey silt or sandy silt (including silt) in the 2-3 layer. This layer shall then be replaced by

backfilling with yellow brown silty clay from layer 2-1. The compaction density for the backfilling soil shall be at least 87% the maximum density.

- h. When excavating the drainage ditches in the pavement area, no damage, or cracking to the compacted foundations on either sides shall be permitted, and the density of these foundations shall not be reduced. If this is not possible, additional reinforcement measures shall be taken for any foundations affected.

4.2.3.2 Macadam Stone Bedding

Macadam stone bedding work shall conform to Section 3.1.1 of this Special Provision.

4.2.3.3 Concrete Work

4.2.3-3.1 GENERAL. The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified herein. All machinery and equipment owned or controlled by the Contractor, which he proposes to use on the work, shall be of sufficient size to meet the requirements of the work, and shall be such as to produce satisfactory work; all work shall be subject to the inspection and approval of the Engineer.

4.2.3-3.2 CONCRETE CLASS. The classes of concrete to be used in the structural concrete works shall be those shown on the Drawings and designated in Table 3, in which the class designation includes two factors. The first factor is the characteristic compressive strength (minimum flexural strength) at 28 days by specimens test (cylinder test) and the second factor is the maximum size of aggregates in the mix expressed in mm. The characteristic strengths given in Table 3 herein below shall be measured in accordance with JTJ 053-94.

Table 3 Concrete Classes for Structural Concrete Works

Description of Class	C30/C25	C20/C16	C15/C10
Maximum size of coarse aggregate mm	20	20	20
Consistency (Slump), cm	7.5 ± 2.5	7.5 ± 2.5	7.5 ± 2.5
Maximum cement content, ratio (W/C), %	50	60	65
Minimum cement content, Kg per cu. m.	300	220	150
Minimum compressive strength at 28 days by cylinder test Kg f per sq.cm	250 (25N/MM ²)	160 (16N/MM ²)	120 (12N/MM ²)
Type of Uses	Precast RC members	In-situ Concrete	Leveling concrete

4.2.3-3.3 ACCEPTANCE SAMPLING AND TESTING. Concrete for each structure will be accepted on the basis of the compressive strength specified in paragraph 3.2. The concrete shall be sampled in accordance with ASTM C 172 or JTJ 053-94. Compressive strength specimens shall be made in accordance with ASTM C 31 or JTJ 053-94 and tested in accordance with ASTM C 39 or JTJ 053-94.

Concrete cylindrical test specimens shall be made in accordance with ASTM C 31 and tested in accordance with ASTM C 39. The Contractor shall cure and store the test specimens under such conditions as directed. The Engineer will make the actual tests on the specimens at no expense to the Contractor.

4.2.3-3.4 PROPORTIONING AND MEASURING DEVICES. When package cement is used, the quantity for each batch shall be equal to one or more whole sacks of cement. The aggregates shall be measured separately by weight. If aggregates are delivered to the mixer in batch trucks, the exact amount for each mixer charge shall be contained in each batch compartment. Weighing boxes or hoppers shall be approved by the Engineer and shall provide means of regulating the flow of aggregates into the batch box so that the required and exact weight of aggregates can be readily obtained.

4.2.3-3.5 CONSISTENCY. The consistency of the concrete shall be checked by the slump test specified in ASTM C 143 or JTJ 053-94.

4.2.3-3.6 MIXING. Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C 94 or GBJ 10-65.

4.2.3-3.7 MIXING CONDITIONS. The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 4 C without permission of the Engineer. If permission is granted for mixing under such conditions, aggregates or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 10 C nor more than 38 C. The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his/her expense.

Retempering of concrete by adding water or any other material shall not be permitted.

The delivery of concrete to the job shall be in such a manner that batches of concrete will be deposited at uninterrupted intervals.

4.2.3-3.8 FORMS. Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the Engineer. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as designed on the Drawings. The forms shall be true to line and grade and shall be

mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The Contractor shall bear responsibility for their adequacy. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes.

The internal ties shall be arranged so that, when the forms are removed, no metal will show in the concrete surface or discolor the surface when exposed to weathering. All forms shall be wetted with water or with a nonstaining mineral oil which shall be applied shortly before the concrete is placed. Forms shall be constructed so that they can be removed without injuring the concrete or concrete surface. The forms shall not be removed before the expiration of at least 30 hours from vertical faces, walls, slender columns, and similar structures; forms supported by falsework under slabs, beams, girders, arches, and similar construction shall not be removed until tests indicate that at least 60% of the design strength of the concrete has developed.

4.2.3-3.9 **PLACING REINFORCEMENT.** All reinforcement shall be accurately placed, as shown on the Drawings, and shall be firmly held in position during concreting. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

4.2.3-3.10 **EMBEDDED ITEMS.** Before placing concrete, any items that are to be embedded shall be firmly and securely fastened in place as indicated. All such items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The embedding of wood shall be avoided. The concrete shall be spaded and consolidated around and against embedded items.

4.2.3-3.11 **PLACING CONCRETE.** All concrete shall be placed during daylight, unless otherwise approved. The concrete shall not be placed until the depth and character of foundation, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved. Concrete shall be placed as soon as practical after mixing and in no case later than 1 hour after water has been added to the mix. The method and manner of placing shall be such to avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. Dropping the concrete a distance of more than 1.5 m, or depositing a large quantity at one point, will not be permitted. Concrete shall be placed upon clean, damp surfaces, free from running water, or upon properly consolidated soil.

The concrete shall be compacted with suitable mechanical vibrators operating within the concrete. When necessary, vibrating shall be supplemented by hand spading with suitable tools to assure proper and adequate compaction. Vibrators shall be manipulated so as to work the concrete thoroughly around the reinforcement and embedded fixtures and into corners and angles of the forms.

The vibration at any joint shall be of sufficient duration to accomplish compaction but shall not be prolonged to the point where segregation occurs. Concrete deposited under water shall be carefully placed in a compact mass in its final position by means of a tremie, a closed bottom dump bucket, or other approved method and shall not be disturbed after being deposited.

- 4.2.3-3.12 **CONSTRUCTION JOINTS.** When the placing of concrete is suspended, necessary provisions shall be made for joining future work before the placed concrete takes its initial set. For the proper bonding of old and new concrete, such provisions shall be made for grooves, steps, keys, dovetails, reinforcing bars or other devices as may be prescribed. The work shall be arranged so that a section begun on any day shall be finished during daylight of the same day. Before depositing new concrete on or against concrete which has hardened, the surface of the hardened concrete shall be cleaned by a heavy steel broom, roughened slightly, wetted, and covered with a neat coating of cement paste or grout.
- 4.2.3-3.13 **EXPANSION JOINTS.** Expansion joints shall be constructed at such points and of such dimensions as may be indicated on the Drawings. The premolded filler shall be cut to the same shape as that of the surfaces being joined. The filler shall be fixed firmly against the surface of the concrete already in place in such manner that it will not be displaced when concrete is deposited against it.
- 4.2.3-3.14 **SLIP BARS.** Slip bars shall be placed across joints in the manner as shown on the Drawings. They shall be of the dimensions and spacings as shown and held rigidly in the middle of the slab depth in the proper horizontal and vertical alignment by an approved assembly device to be left permanently in place. The dowel or load-transfer and joint devices shall be rigid enough to permit complete assembly as a unit ready to be lifted and placed into position. A PVC sleeve shall be furnished for each slip bar used with expansion joints. These sleeves shall be substantial enough to prevent collapse and shall be placed on the ends of the dowels as shown on the Drawings. The sleeves shall fit the slip bar tightly and the closed end shall be watertight. The portion of each dowel painted with rust preventative paint shall be thoroughly coated with asphalt MC-70, or an approved lubricant, to prevent the concrete from bonding to that portion of the dowel. If free-sliding plastic-coated or epoxy-coated steel dowels are used, a lubrication bond breaker shall be used except when approved pullout tests indicate it is not necessary.
- 4.2.3-3.15 **DEFECTIVE WORK.** Any defective work disclosed after the forms have been removed shall be immediately removed and replaced. If any dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows honeycomb, which in the opinion of the Engineer cannot be repaired satisfactorily, the entire section shall be removed and replaced at the expense of the Contractor.
- 4.2.3-3.16 **SURFACE FINISH.** All exposed concrete surfaces shall be true, smooth, free from open or rough spaces, depressions, or projections. The concrete in horizontal plane

surfaces shall be brought flush with the finished top surface at the proper elevation and shall be struck-off with a straightedge and floated. Mortar finishing shall not be permitted, nor shall dry cement or sand-cement mortar be spread over the concrete during the finishing of horizontal plane surfaces.

When directed, the surface finish of exposed concrete shall be a rubbed finish. If forms can be removed while the concrete is still green, the surface shall be pointed and wetted and then rubbed with a wooden float until all irregularities are removed. If the concrete has hardened before being rubbed, a carborundum stone shall be used to finish the surface. When approved, the finishing can be done with a rubbing machine.

4.2.3-3.17 CURING AND PROTECTION. All concrete shall be properly cured and protected by the Contractor. The work shall be protected from the elements, flowing water, and from defacement of any nature during the building operations. The concrete shall be cured as soon as it has sufficiently hardened by covering with an approved material. Water-absorptive coverings shall be thoroughly saturated when placed and kept saturated for a period of at least 3 days. All curing mats or blankets shall be sufficiently weighted or tied down to keep the concrete surface covered and to prevent the surface from being exposed to currents of air. Where wooden forms are used, they shall be kept wet at all times until removed to prevent the opening of joints and drying out of the concrete. Traffic shall not be allowed on concrete surfaces for 7 days after the concrete has been placed.

4.2.3-3.18 DRAINS OR DUCTS. Weep holes, drainage pipes, conduits, and ducts that are to be encased in concrete shall be installed by the Contractor before the concrete is placed. The pipe shall be held rigidly so that it will not be displaced or moved during the placing of the concrete.

4.2.3-3.19 COLD WEATHER PROTECTION. When concrete is placed at temperatures below 4 C, the Contractor shall provide satisfactory methods and means to protect the mix from injury by freezing. The aggregates, or water, or both, shall be heated in order to place the concrete at temperatures between 10 and 38 C.

After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the mix at not less than 10 C until at least 60% of the designed strength has been attained.

4.2.3-3.20 FILLING JOINTS. All joints which require filling shall be thoroughly cleaned, and any excess mortar or concrete shall be cut out with proper tools. Joint filling shall not be started until after final curing and shall be done only when the concrete is completely dry. The cleaning and filling shall be carefully done with proper equipment and in a manner to obtain a neat looking joint free from excess filler.

4.2.3.4 Cement Mortar

a. General

- (1) Mortar shall be used ahead of concrete placing, or applied in the cases specified elsewhere in this Specification Document, or whenever required during the progress of the Works as directed by the Engineer.
- (2) The mix proportions shall be as stated on the Drawings or specified elsewhere in these specifications, or if not stated shall be one part of cement to two parts of fine aggregates by weight.
- (3) Small quantities of mortar shall be hand mixed, but for amounts of over 0.5 m³ a mechanical mixer shall be used.
- (4) The water content of the mortar shall be as low as possible and consistent with the use for which it is required but in any case the water/cement ratio shall not be more than 0.5.

b. Dry Pack Mortar

- (1) Dry pack mortar shall comprise one part of cement and two parts of fine aggregates (as approved for structural concrete) with only sufficient water to permit full hydration of cement such that it becomes cohesive but not plastic when it is squeezed in the hand.
- (2) In filling the voids under the base plates or in other areas where the structural integrity depends on the transfer of loads, dry pack mortar may be permitted.
- (3) Dry pack mortar shall be mixed in such quantities that it can be placed and compacted within 30 minutes of mixing.
- (4) Dry pack mortar shall be placed in layers in the voids to be filled and each layer thoroughly compacted by ramming with a wooden tool specifically designed for the purpose. If the void is sufficiently large, mechanical rammer may be used, but under no circumstances shall the mechanical rammers come into contact with the edges of the voids to be filled.

4.2.3.5 Backfilling

- a. After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the Drawings and compacted by mechanical equipment to at least 90% of the maximum density as

determined by ASTM D 698 or JTG 051-93. The in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTG 051-93.

b. Backfilling for the drainage ditches shall be as set forth below:

- (1) Type II U-shaped ditches with covers, box culverts with covers, and double box culverts shall be backfilled using a material mixture of cement, fly ash, crushed stone and water. The mixture shall be 5 parts cement, 25 parts fly ash and 70 parts crushed stone (dry weight ratios), and the cement shall be ordinary portland cement No. 425. The crushed stone shall be 0-50 mm stone particles without sieving. The water content shall be 120-150 kg per 1 m³ of mixture. The backfilling shall be compacted for each layer using a vibrating roller, and shall be laid at a thickness of 60 cm per layer.
- (2) Type I and III ditches with covers, box culverts with covers, U-shaped ditches, and double box culverts, shall be backfilled with sandy soil. It shall not be permissible to use till soil or clayey soil for backfilling. The work shall be performed through manual compacting or using light machinery, in several layers, so that the compaction density is at least 90% of the maximum density.

4.2.3.6 Clearing and Restoration of Site

- a. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.
- b. After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear and in good condition.
- c. Performance of the work described in this section is not payable directly but shall be considered as a subsidiary obligation of the Contractor, covered under the Contract unit price for the concrete structure.

4.2.4 Method of Measurement

4.2-4.1 The quantity of unclassified excavation for concrete structures to be paid for shall be the number of cubic meters, measured in original position, of material excavated in accordance with the Drawings, or as directed by the Engineer.

4.2-4.2 Concrete shall be measured by the number of cubic meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for forms, falsework, cofferdams, pumping,

bracing, or finishing of the concrete. No deductions shall be made for the volumes occupied by reinforcing steel, anchors, conduits, weep holes, or embedded items.

- 4.2-4.3 Macadam stone bedding or backfilling shall be measured by the number of cubic meters of materials compacted in place and accepted.
- 4.2-4.4 Expansion joint board shall be measured by the number of square meters of materials in place, completed, and accepted.
- 4.2-4.5 Joint sealing shall be measured by the number of linear meters of materials in place, completed, and accepted.
- 4.2-4.6 Reinforcing steel shall be measured by the calculated theoretical number of tons placed, as shown on the Drawings, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size.

4.2.5 Basis of Payment

- 4.2-5.1 Payment shall be made at the Contract unit price per cubic meter for excavation or in-situ concrete, or macadam stone bedding or backfilling; at the Contract unit price per square meter for expansion joint board; at the Contract unit price per meter for joint sealing; and at the Contract unit price per ton for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, delivering, placing and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-3-2(Area A)	Box Culvert, U-shape Ditch	
8*	Excavation	cubic metre
2*	In-situ concrete (C30)	cubic metre
7*	In-situ concrete (C20)	cubic metre
14*	Leveling concrete (C15)	cubic metre
15*	Macadam stone bedding	cubic metre
9*	Backfilling with ordinary soil	cubic metre
10*	Backfilling with 12%-lime soil	cubic metre
13*	Expansion board (T 2cm)	square metre
12*	PUT joint sealing (W0.8cm)	metre
	Slip bar	ton
16*,17*	Reinforcement bar	ton
	Cement mortar (M15)	square metre

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 4.3 PRECAST CONCRETE COVER

4.3.1 Description

4.3-1.1 This item shall consist of fabrication, hauling and installation of precast reinforced concrete cover in accordance with these specifications at the specified locations in accordance with the dimensions, lines, and grades as shown on the Drawings.

4.3.2 Materials

4.3-2.1 CONCRETE. Precast reinforced concrete including cement, aggregates, reinforcing bar, and mortar, and so on shall meet the requirements of Section 4.2 of this Special Provision.

4.3.3 Construction Methods

4.3-3.1 FABRICATION. The forms for and the mixing, placing, finishing, and curing of concrete and placement of reinforcement shall conform to the requirements of Section 4.2 of this Special Provision.

4.3-3.2 PLACING

- a. The surface of concrete covers must be smooth and flat, and the size must be accurate. There must be no missing edges or angles, or damage caused by hard objects.
- b. When placing the covers, the strength of the concrete must not be less than the design strength required for lifting and assembly, and must be at least 70% of the design strength.
- c. Tolerances for precast concrete covers shall be:

Height: ± 3 mm

Length, Width: ± 5 mm

- d. For Type II drainage ditches with covers in the apron area, the covers shall be laid prior to placing the paving concrete in the area surrounding the drainage ditches. The covers shall be laid so that the neighboring covers line up flat. A 3 m length

gauge shall be used for measuring to confirm the vertical alignment with the drainage channels, at a test interval of 20 m. Measured values for level differences of 5 mm or more shall be less than 15%, and the maximum value shall not exceed 8 mm.

- e. The covers shall fit firmly the underlying U-shape channel, and all voids and joints shall be filled with cement mortar.

4.3.4 Measurement and Payment

a. Measurement

Precast concrete shall be measured by the cubic meter in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No deductions shall be made for the volume occupied by reinforcing steel and other embedded items.

b. Payment

Payment for precast concrete cover shall be made at the Contract unit price per cubic meter separately either for fabrication, or hauling or installation of the precast concrete covers. These prices shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-3-2(Area A)	Box Culvert, U-shape Ditch	
4*	Fabrication	cubic metre
5*	Hauling	cubic metre
	Installation	cubic metre

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 4.4 STEEL GRATING

4.4.1 Description

4.4-1.1 This item shall consist of fabrication, hauling and installation of steel grating cover in accordance with these specifications at the specified locations in accordance with the dimensions, lines, and grades as shown on the Drawings.

4.4.2 Materials

4.4-2.1 Materials for steel grating cover and its bearing frame shall be cast or rolled steel for general structural steel conforming to the requirements of GB [], or JIS G 3101, or ASTM A 36 - 74. Its surfaces shall be hot-dipped galvanized in accordance with the requirements of AASHTO M-111 or GB [].

4.4-2.2 The following two types of grating cover shall be used as shown on the Drawings or directed by the Engineer.

a. Type A cast steel grating cover (E-1)

b. Type B cast steel grating cover (E-2)

4.4-2.3 The Contractor shall submit to the Engineer mill test reports certifying that the materials meet the specified requirements.

4.4-2.4 Care shall be exercised to protect steel grating from dust, oil, the like and from deterioration, when stored.

4.4.3 Construction Requirements

4.4-3.1 Grating covers and bearing frames shall be fastened with sufficient bolts so as to prevent backlash due to traffic.

4.4-3.2 Measures must be taken prior to welding to prevent steel grating covers from springing back and losing their flatness.

4.4-3.3. There must be no air holes visible from the exterior of the welding joints, nor any dross, or cracks, and there must be no welding defects, including welding lumps. Each welding joint must have the same welding depth, and a consistent width. After welding and properly tapping, the welded joints must be painted with anti-rust paint.

4.4-3.4 The finished surface of grating shall be exactly even with the adjacent pavement surfaces in order to secure smooth wheel passing. The surface tolerances shall be as follows:

Tolerances for Steel Grating Cover Measurements

Inspection Category	Tolerance (mm)
Length, Width and Height	± 2
Opposite Angle Line	± 3
Plate Interval	± 1.5
Flat Spring Back	2

4.4.4 Measurement and Payment

a. Measurement

Steel grating cover shall be measured by the number of ton of steel grating complete in place and accepted in accordance with the dimensions shown on the Drawings or ordered by the Engineer.

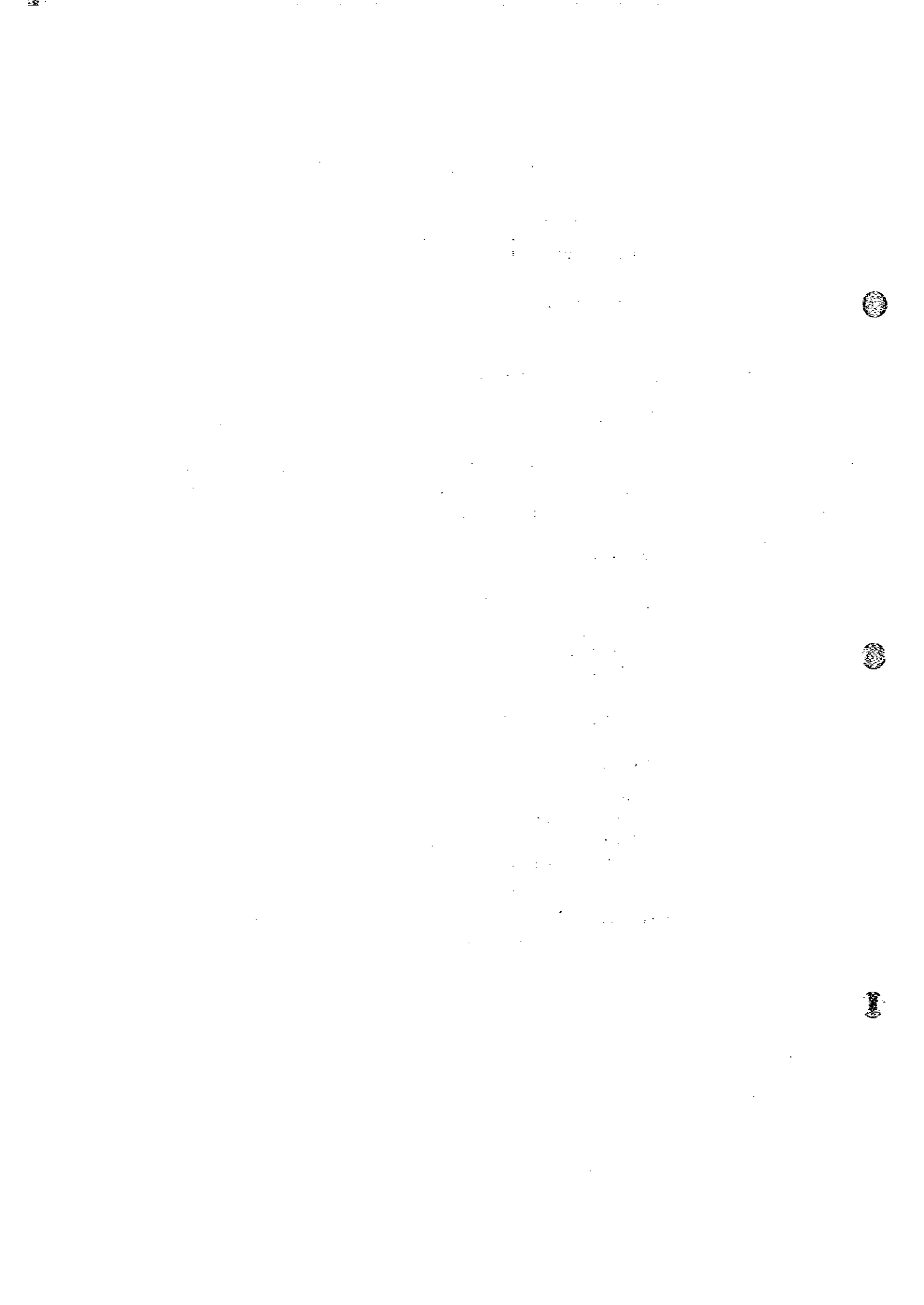
b. Payment

Payment for steel grating cover shall be made at the Contract unit price per ton separately either for fabrication, or hauling or installation of the steel grating. These prices shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-3 (Area A)		
2-18*	Fabrication of Type A grating	ton
2-19*	Fabrication of Type B grating	ton
2-21*	Hauling	ton
	Installation	ton

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.



CHAPTER 5 REGULATING POND AND PUMP STATION

SECTION 5.1 REGULATING POND

5.1.1 Description

This item shall consist of regulating pond constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Drawings or requested by the Engineer.

5.1.2 Materials

Stones to be pitched and mortar for joint sealing shall conform to Section 4.1 of this Special Provision.

5.1.3 Construction Methods

5.1-3.1 UNCLASSIFIED EXCAVATION.

- a. Excavation shall be made to the required width and depth, and the subgrade upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness indicated on the Drawings, shall be placed to form a foundation base.
- b. When using equipment to excavate the drain ditches, care must be taken to ensure that no damage is caused to the soil structure for the bottom of the ditch. If it is difficult to accurately level or smooth the ditch based on the height of the bottom of the drain ditch, the equipment shall be used to excavate only to a depth that is 20 cm above the planned ditch height, and the remaining excavation must be performed manually.
- c. The excavated materials suitable for embankment and filling shall be hauled to and deposited at the designated stockyard or fill areas.
- d. Compacting shall be performed for the soil and macadam stone bedding layers on the banks of the wet masonry ditches and the regulating ponds. After excavation, gray silty clay for the 2-2 layer on the banks shall be partially replaced by gravel. The depth of this replacing layer shall follow the planned slopes for the drainage ditches and shall be at least the thickness of the 2-2 layer.

5.1-3.2 STONE PITCHING

- a. Prior to placing stones, the foundation base upon which the stone pitching is to be built shall be prepared. A 10 cm thick gravel layer shall be laid on the foundation base shown on the Drawings.
- b. Rubble stone shall be securely placed by hand, and voids shall be avoided to the extent possible. The face surfaces of all rubble stones shall form a smooth regular surface conforming to the shape of the ditch. No rubble stone surface shall extend more than one and a half centimeters above or below the general level of the ditch.
- c. All voids between stones shall be filled flush with mortar but the face surface of the stone shall be left exposed. Mortar shall be placed from bottom to top and the surface swept with a stiff broom. The surface shall be cured for a period of at least three days.
- d. When interrupting work, spaces in the stone layers already laid must be filled completely with mortar so that the stones do not loosen or move. When laying the stone begins again, the surface of the stone layer must be cleaned properly, and the layer shall be moistened by sprinkling water.
- e. Stacking of rubble stones during each day shall not exceed a height of 1.2 m.
- f. The tolerances for mortared rubble stone shall be as stated in the following table:

Tolerances by Category for Mortar Stone Masonry Drain Ditches

Inspection Category	Tolerance (mm)
Center Line	± 20
Wall Axis	± 15
Height Near Wall Roof, Height Near Cover Roof	± 0, -20
Surface Smoothness of Wall (Measure With a 2 m Straightedge)	20
Thickness of Wall	± 20
Vertical Straightness of Sides and Vertical Straightness of Sinking Joints	20

5.1-3.3 **WEEP HOLES.** Weep (outlet) holes shall be constructed as shown on the Drawings. A 40 mm x 40 mm geo-textile shall be attached to the lower end of each weep hole shown on the Drawings.

5.1-3.4 **JOINT SEALING**

- a. Expansion joints shall be formed at a maximum spacing of 10 meters. Joints shall be 20 mm in width and shall extend through the complete wall and bottom lining. Rubble stones used for joint forming shall be selected so as to form a clean vertical joint of dimension specified above.

- b. Before sealing the joints, the wall surface shall be cleaned thoroughly to remove any mortar, soiling or debris, and the wall surface shall be moistened by sprinkling water.
- c. The form of the joints for the rubble stone masonry, and the grade of the mortar shall be as set forth in the Drawings.
- d. The mortaring for the joints must maintain the natural joining of the stone masonry. When mortaring convex joints, it shall be required that the mortar joints shall be aligned, that the corners shall be rounded and smooth, that the widths shall be uniform, and that the joints be firmly packed, and there must be no splitting or any cracks.

5.1.4 Method of Measurement

- 5.1-4.1 The quantity of unclassified excavation for regulating pond to be paid for shall be the number of cubic meters, measured in original position, of materials excavated and hauled in accordance with the Drawings, or as directed by the Engineer.
- 5.1-4.2 Masonry work shall be measured by the number of cubic meters of stone pitching, complete in place and accepted. In computing the volume of stone masonry for payment, the dimensions used shall be those shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for gravel layers, and weep holes with geo-textiles. No deductions in volume shall be made for the volumes of embedded items.
- 5.1-4.3 Joint sealing shall be measured by the number of square meters of materials in place, completed and accepted. No measurements or other allowances shall be made for expansion joint materials.

5.1.5 Basis of Payment

- 5.1-5.1 Payment will be made at the Contract unit price per cubic meter for unclassified excavation and hauling of materials for regulating pond; at the Contract unit price per cubic meter for masonry work; and at the Contract unit price per square meter for joint sealing. These prices shall be full compensation for furnishing all materials and for all preparation, excavation, hauling and placing the materials, and for all labor, equipment, tools, and incidentals necessary to complete the structure.

The costs of gravel layers, geo-textiles, and weep holes will not be paid for separately but shall be included in the Contract price per cubic meter for masonry work.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-4 (Area A)		
1-1*	Excavation and hauling of soil to fill area	cubic metre
1-2*	Masonry work (T 30cm)	cubic metre
1-3*	Joint sealing	square metre

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 5.2 PUMP STATION

5.2.1 Description

5.2-1.1 This item shall consist of pump station constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Drawings or required by the Engineer.

5.2.2 Materials

5.2-2.1 **STONE BEDDING MATERIALS.** Macadam stone bedding materials shall conform to the requirements of Section 3.1.1 of this Special Provision.

5.2-2.2 **CONCRETE.** Reinforced concrete shall meet the requirements of Section 4.2 of this Special Provision.

5.2-2.3 **ARCHITECTURAL WORKS.** Materials for architectural works shall meet the requirements of Chapter 1 of the Specifications for the Fire Fighting and Rescue Facilities.

5.2.3 Construction Methods

5.2-3.1 UNCLASSIFIED EXCAVATION.

- a. Foundations for pump station shall be excavated to the lines and grades or elevations shown on the Drawings. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.
- b. The foundation base upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness indicated on the Drawings, shall be placed to form a foundation base.
- c. When using equipment to excavate the pump station foundation, care must be taken to ensure that no damage is caused to the soil structure of the foundation bottom. If it is difficult to accurately level or smooth the foundation bottom to the planned elevation, the equipment shall be used to excavate only to a depth that is 20 - 30 cm above the planned bottom elevation, and the remaining excavation must be performed manually.
- d. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All satisfactory materials shall be hauled and placed in fills,

and unsuitable materials shall be placed in spoil areas or as directed by the Engineer.

- 5.2-3.2 **MACADAM STONE BEDDING.** Macadam stone bedding work shall conform to Section 3.1.1 of this Special Provision.
- 5.2-3.3 **CONCRETE WORK.** The forms for and the mixing, placing, finishing, and curing of concrete and placement of reinforcement shall conform to the requirements of Section 4.2 of this Special Provision.
- 5.2-3.4 **ARCHITECTURAL WORK.** Architectural work (exterior and interior finishes, etc.) shall meet the requirements of Chapter 1 of the Specifications for the Fire Fighting and Rescue Facilities.
- 5.2-3.5 **BACKFILLING.** After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the Drawings and compacted by mechanical equipment to at least 90% of the maximum density as determined by ASTM D 698 or JTJ 051-93. The in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTJ 051-93.
- 5.2-3.6 **CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

5.2.4 Method of Measurement

- 5.2-4.1 The quantity of unclassified excavation to be paid for shall be the number of cubic meters, measured in original position, of material excavated and disposed in accordance with the Drawings, or as directed by the Engineer.
- 5.2-4.2 Concrete shall be measured by the number of cubic meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No deductions shall be made for the volumes occupied by reinforcing steel, anchors, conduits, weep holes, or embedded items.
- 5.2-4.3 Formwork shall be measured by the number of square meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for falsework, bracing, or finishing of the concrete.

- 5.2-4.4 Macadam stone bedding or backfilling shall be measured by the number of cubic meters of materials compacted in place and accepted.
- 5.2-4.5 Architectural finish work shall be measured by the number of square meters of materials in place, completed, and accepted.
- 5.2-4.6 Reinforcing steel shall be measured by the calculated theoretical number of tons placed, as shown on the Drawings, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size.

5.2.5 Basis of Payment

- 5.2-5.1 Payment for excavation shall be made at the Contract unit price per cubic meter separately either for machine excavation, or manual excavation, or disposal of materials. These prices shall be full compensation for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.
- 5.2-5.2 Payment shall be made at the Contract unit price per cubic meter for in-situ concrete, or macadam stone bedding or backfilling; at the Contract unit price per square meter for formwork or architectural finish work; and at the Contract unit price per ton for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, delivering, placing and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-4 (Area A)		
2-1*	Machine excavation	cubic metre
2-2*	Manual excavation	cubic metre
2-3*	Disposal of residual Materials	cubic metre
2-4*	In-situ concrete (C20)	cubic metre
2-5*	Leveling concrete (C15)	cubic metre
2-6*	Formwork (floor)	square metre
2-7*	Formwork (wall)	square metre
2-8*	Macadam stone bedding	cubic metre
2-9*	Backfilling with ordinary soil	cubic metre
2-10*	Mortar finish	square metre
2-11*	Reinforcement bar	ton

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 5.3 GATE CHAMBER

5.3.1 Description

- 5.3.1.1 This item shall consist of gate chamber constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Drawings or required by the Engineer.

5.3.2 Materials

- 5.3.2.1 **STONE BEDDING MATERIALS.** Macadam stone bedding materials shall conform to the requirements of Section 3.1.1 of this Special Provision.
- 5.3.2.2 **CONCRETE.** Reinforced concrete shall meet the requirements of Section 4.2 of this Special Provision.
- 5.3.2.3 **ARCHITECTURAL WORKS.** Materials for architectural works shall meet the requirements of Chapter 1 of the Specifications for the Fire Fighting and Rescue Facilities.

5.3.3 Construction Methods

5.3.3.1 UNCLASSIFIED EXCAVATION.

- a. Foundations for gate chamber shall be excavated to the lines and grades or elevations shown on the Drawings. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.
- b. The foundation base upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness indicated on the Drawings, shall be placed to form a foundation base.
- c. When using equipment to excavate the gate chamber foundation, care must be taken to ensure that no damage is caused to the soil structure of the foundation bottom. If it is difficult to accurately level or smooth the foundation bottom to the planned elevation, the equipment shall be used to excavate only to a depth that is 20 - 30 cm above the planned bottom elevation, and the remaining excavation must be performed manually.
- d. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All satisfactory materials shall be hauled and placed in fills,

and unsuitable materials shall be placed in spoil areas or as directed by the Engineer.

5.3-3.2 **MACADAM STONE BEDDING.** Macadam stone bedding work shall conform to Section 3.1.1 of this Special Provision.

5.3-3.3 **CONCRETE WORK.** The forms for and the mixing, placing, finishing, and curing of concrete and placement of reinforcement shall conform to the requirements of Section 4.2 of this Special Provision.

5.3-3.4 **ARCHITECTURAL WORK.** Architectural work (exterior and interior finishes, etc.) shall meet the requirements of Chapter 1 of the Specifications for the Fire Fighting and Rescue Facilities.

5.3-3.5 **BACKFILLING.** After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the Drawings and compacted by mechanical equipment to at least 90% of the maximum density as determined by ASTM D 698 or JTJ 051-93. The in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTJ 051-93.

5.3-3.6 **CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

5.3.4 **Method of Measurement**

5.3-4.1 The quantity of unclassified excavation to be paid for shall be the number of cubic meters, measured in original position, of material excavated and disposed in accordance with the Drawings, or as directed by the Engineer.

5.3-4.2 Concrete shall be measured by the number of cubic meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No deductions shall be made for the volumes occupied by reinforcing steel, anchors, conduits, weep holes, or embedded items.

5.3-4.3 Formwork shall be measured by the number of square meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for falsework, bracing, or finishing of the concrete.

- 5.3-4.4 Macadam stone bedding or backfilling shall be measured by the number of cubic meters of materials compacted in place and accepted.
- 5.3-4.5 Architectural finish work shall be measured by the number of square meters of materials in place, completed, and accepted.
- 5.3-4.6 Reinforcing steel shall be measured by the calculated theoretical number of tons placed, as shown on the Drawings, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size.

5.3.5 Basis of Payment

- 5.3-5.1 Payment for excavation shall be made at the Contract unit price per cubic meter separately either for machine excavation, or manual excavation, or disposal of materials. These prices shall be full compensation for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.
- 5.3-5.2 Payment shall be made at the Contract unit price per cubic meter for in-situ concrete, or macadam stone bedding or backfilling; at the Contract unit price per square meter for formwork or architectural finish work; and at the Contract unit price per ton for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, delivering, placing and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-4 (Area A)		
3-1*	Machine excavation	cubic metre
3-2*	Manual excavation	cubic metre
3-3*	Disposal of residual Materials	cubic metre
3-4*	In-situ concrete (C20)	cubic metre
3-5*	Leveling concrete (C15)	cubic metre
3-6*	Formwork (floor)	square metre
3-7*	Formwork (wall)	square metre
3-8*	Macadam stone bedding	cubic metre
3-9*	Backfilling with ordinary soil	cubic metre
3-10*	Mortar finish	square metre
3-11*	Reinforcement bar	ton

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 5.4 OIL SEPARATOR

5.4.1 Description

5.4-1.1 This item shall consist of oil separator constructed in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Drawings or required by the Engineer.

5.4.2 Materials

5.4-2.1 **STONE BEDDING MATERIALS.** Macadam stone bedding materials shall conform to the requirements of Section 3.1.1 of this Special Provision.

5.4-2.2 **CONCRETE.** Reinforced concrete shall meet the requirements of Section 4.2 of this Special Provision.

5.4.3 Construction Methods

5.4-3.1 UNCLASSIFIED EXCAVATION.

- a. Foundations for oil separator shall be excavated to the lines and grades or elevations shown on the Drawings. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown.
- b. The foundation base upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness indicated on the Drawings, shall be placed to form a foundation base.
- c. When using equipment to excavate the oil separator foundation, care must be taken to ensure that no damage is caused to the soil structure of the foundation bottom. If it is difficult to accurately level or smooth the foundation bottom to the planned elevation, the equipment shall be used to excavate only to a depth that is 20 - 30 cm above the planned bottom elevation, and the remaining excavation must be performed manually.
- d. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All satisfactory materials shall be hauled and placed in fills, and unsuitable materials shall be placed in spoil areas or as directed by the Engineer.

5.4-3.2 **MACADAM STONE BEDDING.** Macadam stone bedding work shall conform to Section 3.1.1 of this Special Provision.

5.4-3.3 **CONCRETE WORK.** The forms for and the mixing, placing, finishing, and curing of concrete and placement of reinforcement shall conform to the requirements of Section 4.2 of this Special Provision.

5.4-3.4 **BACKFILLING.** After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the Drawings and compacted by mechanical equipment to at least 90% of the maximum density as determined by ASTM D 698 or JTJ 051-93. The in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTJ 051-93.

5.4-3.5 **CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankment, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

5.4.4 **Method of Measurement**

5.4-4.1 The quantity of unclassified excavation to be paid for shall be the number of cubic meters, measured in original position, of material excavated and disposed in accordance with the Drawings, or as directed by the Engineer.

5.4-4.2 Concrete shall be measured by the number of cubic meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No deductions shall be made for the volumes occupied by reinforcing steel, anchors, conduits, weep holes, or embedded items.

5.4-4.3 Formwork shall be measured by the number of square meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for falsework, bracing, or finishing of the concrete.

5.4-4.4 Macadam stone bedding or backfilling shall be measured by the number of cubic meters of materials compacted in place and accepted.

5.4-4.5 Reinforcing steel shall be measured by the calculated theoretical number of tons placed, as shown on the Drawings, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size.

5.4.5 Basis of Payment

5.4-5.1 Payment for excavation shall be made at the Contract unit price per cubic meter separately either for machine excavation, or manual excavation, or disposal of materials. These prices shall be full compensation for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.

5.4-5.2 Payment shall be made at the Contract unit price per cubic meter for in-situ concrete, or macadam stone bedding or backfilling; at the Contract unit price per square meter for formwork; and at the Contract unit price per ton for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, delivering, placing and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-4 (Area A)		
4-1*	Machine excavation	cubic metre
4-2*	Manual excavation	cubic metre
4-3*	Disposal of residual Materials	cubic metre
4-4*	In-situ concrete (C20)	cubic metre
4-5*	Leveling concrete (C15)	cubic metre
4-6*	Formwork (floor)	square metre
4-7*	Formwork (wall)	square metre
4-8*	Macadam stone bedding	cubic metre
4-9*	Backfilling with ordinary soil	cubic metre
4-10*	Reinforcement bar	ton

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 5.5 CONTROL ROOM

5.5.1 Description

5.5-1.1 This item shall consist of control room constructed and equiped in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the Drawings or required by the Engineer.

5.5.2 Materials

5.5-2.1 **STONE BEDDING MATERIALS.** Macadam stone bedding materials shall conform to the requirements of Section 3.1.1 of this Special Provision.

5.5-2.2 **CONCRETE.** Reinforced concrete shall meet the requirements of Section 4.2 of this Special Provision.

5.5-2.3 **ARCHITECTURAL WORKS.** Materials for architectural works shall meet the requirements of Chapter 1 of the Specifications for the Fire Fighting and Rescue Facilities.

5.5-2.4 **EQUIPMENT.** This item shall conform to the following specificatio:

a. **Air Conditioning and Ventilation Equipment**

This item shall meet the requirements of Chapter 2 of the Specifications for the Fire Fighting and Rescue Facilities.

b. **Plumbing Work**

This item shall meet the requirements of Chapter 3 of the Specifications for the Fire Fighting and Rescue Facilities.

c. **Electrical Equipment**

This item shall meet the requirements of Chapter 4 of the Specifications for the Fire Fighting and Rescue Facilities.

5.5.3 Construction Methods

5.2-3.1 **UNCLASSIFIED EXCAVATION.**

a. Foundations for control room shall be excavated to the lines and grades or elevations shown on the Drawings. The excavation shall be of sufficient size to

permit the placing of the full width and length of the structure or structure footings shown.

- b. The foundation base upon which the item is to be built shall be compacted to a firm uniform grade. All soft and unsuitable material shall be removed and replaced with suitable approved material. When required, a layer of approved granular material, compacted to the thickness indicated on the Drawings, shall be placed to form a foundation base.
- c. When using equipment to excavate the control room foundation, care must be taken to ensure that no damage is caused to the soil structure of the foundation bottom. If it is difficult to accurately level or smooth the foundation bottom to the planned elevation, the equipment shall be used to excavate only to a depth that is 20 - 30 cm above the planned bottom elevation, and the remaining excavation must be performed manually.
- d. Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All satisfactory materials shall be hauled and placed in fills, and unsuitable materials shall be placed in spoil areas or as directed by the Engineer.

5.5-3.2 **MACADAM STONE BEDDING.** Macadam stone bedding work shall conform to Section 3.1.1 of this Special Provision.

5.5-3.3 **CONCRETE WORK.** The forms for and the mixing, placing, finishing, and curing of concrete and placement of reinforcement shall conform to the requirements of Section 4.2 of this Special Provision.

5.5-3.4 **ARCHITECTURAL WORK.** Architectural work (exterior and interior finishes, etc.) shall meet the requirements of Chapter 1 of the Specifications for the Fire Fighting and Rescue Facilities.

5.5-3.5 **EQUIPMENT INSTALLATION.** Each piece of equipment shall be installed at the locations and positions shown on the Drawings, and in accordance with Chapters 2 to 5 of the Specifications for the Fire Fighting and Rescue Facilities.

5.5-3.6 **BACKFILLING.** After the concrete has set sufficiently, the spaces adjacent to the structure shall be refilled to the required elevation with material specified on the Drawings and compacted by mechanical equipment to at least 90% of the maximum density as determined by ASTM D 698 or JTJ 051-93. The in-place density shall be determined in accordance with ASTM D 1556 or ASTM D 2167 or JTJ 051-93.

5.5-3.7 **CLEANING AND RESTORATION OF SITE.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site.

Surplus dirt may be deposited in embankment, shoulders, or as ordered by the Engineer. The Contractor shall restore all disturbed areas to their original condition.

After all work is completed, the Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

5.5.4 Method of Measurement

5.5-4.1 The quantity of unclassified excavation to be paid for shall be the number of cubic meters, measured in original position, of material excavated and disposed in accordance with the Drawings, or as directed by the Engineer.

5.5-4.2 Concrete shall be measured by the number of cubic meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No deductions shall be made for the volumes occupied by reinforcing steel, anchors, conduits, weep holes, or embedded items.

5.5-4.3 Formwork shall be measured by the number of square meters in accordance with the dimensions shown on the Drawings or ordered by the Engineer. No measurements or other allowances shall be made for falsework, bracing, or finishing of the concrete.

5.5-4.4 Macadam stone bedding or backfilling shall be measured by the number of cubic meters of materials compacted in place and accepted.

5.5-4.5 Architectural finish work shall be measured by the number of square meters of materials in place, completed, and accepted.

5.5-4.6 Reinforcing steel shall be measured by the calculated theoretical number of tons placed, as shown on the Drawings, complete in place and accepted. The unit weight used for deformed bars shall be the weight of plain square or round bars of equal nominal size.

5.5-4.7 The equipment shall be measured in lump sum.

5.5.5 Basis of Payment

5.5-5.1 Payment for excavation shall be made at the Contract unit price per cubic meter separately either for machine excavation, or manual excavation, or disposal of materials. These prices shall be full compensation for furnishing all labor, equipment, tools, and incidentals necessary to complete the item.

5.5-5.2 Payment shall be made at the Contract unit price per cubic meter for in-situ concrete, or macadam stone bedding or backfilling; at the Contract unit price per square meter

for formwork or architectural finish work; and at the Contract unit price per ton for reinforcing steel. These prices shall be full compensation for furnishing all materials and for all preparation, delivering, placing and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

5.5-5.3 The accepted quantities of the equipment will be paid for at the contract unit price in lump sum, complete and in place. This price shall be full compensation for fabrication, testing, delivery, and installation and for all labor, materials, tools, equipment and incidentals necessary to complete the works.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-4 (Area A)		
5-1*	Machine excavation	cubic metre
5-2*	Manual excavation	cubic metre
5-3*	Disposal of residual Materials	cubic metre
5-4*	In-situ concrete (C20)	cubic metre
5-5*	Leveling concrete (C15)	cubic metre
5-7*	Formwork (foundation)	square metre
5-8*	Formwork (floor)	square metre
5-9*	Formwork (wall)	square metre
5-10*	Macadam stone bedding	cubic metre
5-11*	Backfilling with ordinary soil	cubic metre
5-12*	Reinforcement bar	ton
5-13*	Exterior finish	
	1) Wall	square metre
	2) Roof	square metre
	3) Fittings and fixtures	square metre
5-14*	Interior finish	
	1) Wall	square metre
	2) Roof	square metre
	3) Ceiling	square metre
5-15*	Electrical equipment	
	1) Telephone facilities	Lump Sum
	2) Automatic fire alarm facilities	Lump Sum
	3) Lighting equipment	Lump Sum
5-16*	Ventilation equipment	Lump Sum
5-17*	Fire extinguishing equipment	Lump Sum

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

SECTION 5.6 MECHANICAL WORKS

5.6.1 Description

This item shall consist of furnishing and installing drainage pumps, flap valves, trash removal facilities, flood gates and related electrical equipment in accordance with these specifications, at the specified locations and conforming to the details shown on the Drawings or required by the Engineer.

5.6.2 Drainage Pump

a. Type and Requirements

The main drainage pump shall be of the submersible type, directly connected to a plenary reduction gear and driven by a motor.

The pump shall be designed to handle water containing varying amounts of silt, sludge, sand, domestic sewage and sometimes sea water.

The pump shall be designed to operate safely in the reverse direction of rotation brought about by water returning through the pumps at times when the diesel engines are stopped.

The pumps shall be designed to operate satisfactorily throughout the expected range of actual heads.

The operating conditions for the drainage pumps shall be as follows:

Type and Requirements	Main Pump
1) Type:	Submersible
2) Bore	1,200mm dia.
3) Number of units:	10
4) Total capacity: Unit capacity:	10.0 m ³ /s 2.0 m ³ /s
5) Total dynamic head including screen friction loss	2.930 m
6) Expected range of actual head:	2.350 m
7) Rated actual head:	
8) Pump Speed:	493 min ⁻¹
9) Motor output: not less than	90 kW
10) Pump efficiency not less than:	80%
11) Driving Method:	water level control
12) Lubricating Method:	
13) Hydrostatic test pressure not less than:	

EXPECTED RANGE OF ACTUAL HEADS

Particulars	Main Pump
1. Water Level:	Submersible
1.1 Suction H.W.L	+2.350 m
L.W.L	±0.000 m
LLWL	-1.000 m
1.2 Discharge H.H.W.L.	+3.800 m
L.W.L	+2.350 m
2. Maximum Actual Head:	
Discharge water level	+2.800 m
Suction (Estero) water level at pump pit	-2.400 m
Max. Actual Head	3.800 m
3. Minimum actual head:	0.000 m
4. Starting Level:	+2.350 m

b. Manufacturing and Materials

(1) Suction Casings

Suction casings of main pumps shall be made of cast iron conforming to the requirements of JIS designation FC-250 or equivalent high grade cast iron.

(2) Guide Casing

Pump guide casing shall be made of cast iron conforming to the requirements of JIS designation FC-250 or equivalent high grade cast iron.

(3) Impeller

Impeller shall be of axial flow type and shall be made of JIS designation stainless steel alloy to resist abrasive and corrosive effects of silt, sludge, sand, domestic sewage, and sea water.

c. Tests at the Manufacturer's Shop

Before dispatching from the manufacturer's shop, all pumps shall be assembled to prove the satisfactory functions.

The performance test of all drainage pumps shall be carried out by manufacturer and at least one unit shall be witnessed by the Engineer or his representative in accordance with the applicable provisions of the latest JIS B 8301 "Testing Methods for Centrifugal Pumps, Mixed Flow Pumps and Axial Flow Pumps" or equivalent.

d. Accessories

Pump accessories to be furnished shall be as follows:

- (1) One set of compound gauge for each pump.
- (2) One set of vacuum gauge for each pump.
- (3) One set of siphon breaker valve for each pump.
- (4) tools for maintenance.
- (5) All other necessary accessories such as lifting slings, lifting eye bolts for installation and maintenance of pump.

e. Spare Parts

Spare parts shall be interchangeable with each pump and shall be of the same materials and workmanship. The spare parts to be furnished for each pump shall be as follows:

- (1) Two sets of sleeves
- (2) Two sets of stuffing box packing and seals

5.6.3 Suction and Discharge Pipes and Flap Valves

Suction and/or discharge pipes for the drainage pump shall be supplied, as shown in the Drawings. Flap valves shall be provided at the discharge ends to prevent reverse flow when the pump is stopped.

a. Type and Requirements

Operating conditions for the suction and/or discharge pipe and flap valve shall be as follows:

Type and Requirements	Main Pump
1. Bore of Pipe: mm	1,200
2. Number of Pipes:	10
3. Type of connection: mm	1,200
4. Thickness of pipe not less than mm	13.1
5. Hydrostatic Test Pressure: Kg/cm ²	10
6. Bore of Flap Valve: mm	1,200
7. Number of Units:	10

b. Manufacturing and Materials

(1) Suction and/or Discharge Pipes

Suction and/or discharge pipes for the drainage pumps shall be made of JIS designation rolled steel (SS-400) or equivalent special steel, and shall have the necessary bends, loose flange, flexible joint, etc.

Flanges shall be of the full-face type and suitable gaskets shall be provided at each joint face of the flanges. Dimension of the pipe flanges shall conform to JIS 2 Kg/cm² class or higher class flange.

(2) Flap Valves

Flap valves shall be of multi-split swing type and shall be made of JIS designation rolled steel (SS-400) or equivalent special steel. Valve seats shall be of JIS designation carbon steel or equivalent material.

5.6.4 Trash Removal Facilities

a. General

The work consists of manufacturing, delivery, installation, testing and commissioning of trash removal facilities. The facilities shall consist of

automatic trash rakes and screens installed at each pump intake, horizontal and vertical belt conveyors and hoppers.

The work shall also include training of local staff in the operation of trash removal facilities.

b. Automatic Trash Rakes and Screens

(1) Type and Requirements

Type and Requirements	Main Pump
1. Type:	Pin-rack
2. Effective width of intake canal	2.0 m
3. Height of intake canal:	4.0 m
4. Pitch of Screen:	50 mm
5. Angle of Screen:	75°
6. Length of rake:	9.0 m
7. Number of rakes:	35
8. Rake speed:	6.0 m/min
9. Output:	2.2 kw
10. Moving method of rake:	
11. Number of units:	14

(2) Manufacturing and Materials

Automatic trash rake and screen shall be made of JIS designation rolled steel (SS-400), or equivalent material. The trash rakes shall be supported by the rake chain in steel channels embedded in both sides of the intake canal wall.

(3) Accessories

The accessories of the automatic trash rake and screen to be furnished shall be as follows:

- | | |
|--|-------|
| 1. Supporting frame for each unit | 1 set |
| 2. Screen for each unit | 1 set |
| 3. Driving Motor, fluid coupling and gear box | 1 set |
| 4. Tools for all units (list to be submitted with shop drawings) | 1 set |

(4) Spare Parts

The spare parts to be furnished for each automatic trash rake and screen shall be as follows:

1. One set of link for each kind of rake chain
2. One set of fuse plug for hydraulic coupling

c. Horizontal Belt Conveyor

(1) Type and Requirements

Item	
1. Type:	Horizontal Rubber Belt
2. Width:	600 mm
3. Length:	27 m
4. Capacity:	20 t/h
5. Belt Speed:	4 ~ 15 m/min
6. Output:	3.0 kw
7. Number of Units:	2

Horizontal belt conveyor shall catch up and convey the trash accumulated by the trash rake and screen. In order to withstand impact when the trash falls, the carrier roller shall be of the impact type with a trough angle of 20° and consist of three sets of rollers. The return roller shall be steel fabricated. The conveyor shall be provided with a steel fabricated skirt along its entire length to prevent spillage. The conveyor skirt shall be arranged on its width to collect the dropping trash from screen, especially skirt at screen side, in order to operate the rake without hindrance.

An adequate number of plys shall be provided against the maximum tension to be applied in the rubber belt.

Cleaning of the belt top surface shall be performed by a head scraper provided under the head pulley. Calculation sheets of the capacity for conveying trash shall be submitted with the tender documents in the tender.

(2) Material

1. Frame Rolled Steel (JIS G 3101 SS-400) or equivalent
2. Belt Rubber (Neoprene) approved by the Engineer.

(3) Accessories

- | | |
|--|-------|
| 1. Supporting Frame | 1 set |
| 2. Driving Motor with gear box | 1 set |
| 3. Tools (list to be submitted with shop drawings) | 1 set |

(4) Spare Parts

The spare parts to be furnished for the horizontal conveyor shall be as follows:

1. 3 pcs of carrier roller
2. 1 pc of return roller

d. Vertical Belt Conveyor

(1) Type and Requirements

Item	
1. Type	Rubber belt with fins turning frame and rail
2. Width	2,700 mm
3. Height	5.0 m
4. Capacity	20 t/h
5. Output	5.5 kw
6. Number of Units	2

Vertical belt conveyor shall be positioned at the end next to the horizontal belt conveyor.

Rubber belt for the inclined belt conveyor with fins or cleats shall be used in order to perform effective transportation in inclined positions.

The rubber belt shall be of three (3) ply type to convey the trash effectively.

Vertical belt conveyor shall provide the rail and frame for its turning movement as shown on the Drawings which will be used when the stored trash is on full capacity in the storage hopper.

The collected trash from the horizontal conveyor shall be carried out by the vertical belt conveyor into a storage hopper.

(2) Material

- | | |
|---|--------|
| 1. Frame | Rolled |
| Steel (JIS G 3101 SS-400) or equivalent | |
| 2. Belt | Rubber |
| (Neoprene) approved by the Engineer. | |

(3) Accessories

- | | |
|--|-------|
| 1. Driving Motor with gear box | 1 set |
| 2. Tools (list to be submitted with shop drawings) | 1 set |

(4) Spare Parts

The spare parts to be furnished for the inclined conveyor shall be as follows:

1. two (2) pieces of carrier roller

e. Hopper

(1) Type and Requirements

Item	
1. Type:	Hopper type
2. Size: mm	1,800W × 1,800B × 2,000H
3. Volume	Approx. 3 m ³
4. Height under hopper:	Approx. 2,500 mm
5. Output:	1.5 kw × 2 units
6. Number of Units	2 unit

Storage hopper shall be constructed with sufficient rigidity to receive and store the trash transported by the inclined belt conveyor.

The four (4) pedestal frame shall be made of welded steel structures to support the hopper. A platform with hand rails and a ladder shall be provided for hopper maintenance.

The hopper shall be made of welded steel plats with sufficient reinforcement. The gate at the bottom shall be of double door type with each door leaf operated by an independent power cylinder. Open and close limit switches shall be provided for each door leaf to be located at full open and full close positions.

(2) Material

All materials shall be rolled steel (JIS G 3101 SS-400) or equivalent.

(3) Accessories

- | | |
|--|--------|
| 1. Motor for operation of hopper bottom cover | 2 sets |
| 2. Tools (list to be submitted with shop drawings) | 1 set |

(4) Spare Parts

The spare parts to be furnished for the hopper shall be as follows:

1. one (1) set of limit switch

f. Tests

Before dispatching from the manufacturer's shop, the equipment shall be assembled to prove the satisfactory functions. The test items will be specified in Subsection 5.6.7

Trash removing facilities shall be installed as shown on the approved shop drawings. After installation has been completed, the facilities shall be tested to prove that it functions satisfactorily with the pumping equipment.

5.6.5 Flood Gates and Stop Logs

(a) Type and Requirements

Floodgates and stop logs shall be provided for each pumping station and at designated individual places. Floodgates shall be of sluice type, operated by an electric motor driven winch and manual operating mechanism including control equipment and all other miscellaneous parts/accessories.

The gates and stop logs shall consist of gate leaf and gate frame complete with skin plates, main beams, seals, hoisting devices and all other necessary components, and shall be of welded construction. The details of construction of the gates and stop logs, not specified herein, shall be made and installed by the Contractor upon approval of the Engineer.

The design conditions and requirements for flood gates are as follows:

Type and Requirements	Area-A	Area-B
1. Type	Sluice gate	Sluice gate
2. Quantity	1 set	1 set
3. Effective span (mm)	2,000	2,000
4. Effective height (mm)	2,000	2,000
5. Design depth (mm)	2,700	2,700
6. Operation depth (mm)	1,250	1,250
7. Gate sill level (m)	+1.100	+1.200
8. Lifting height (mm)	2,500	2,500
9. Hoisting method	Dual operation, manual handle and electric motor	
10. Sealing system	4 sides watertight with rubber seal	
11. Operation method	Site operation and remote control from operation room	
12. Material	As shown on the Drawings	
13. Corrosion allowance	3 mm for skin plate and 2 mm for other main members	
14. Spare Parts	1. One (1) set of rubber sheet packings 2. One (1) set of bearings (business) for roller	

The design conditions and requirements for stop logs are as follows:

Type and Requirments	For each Area
1. Type	Steel fabricated type with rubber seal
2. No. of stop log (set)	one (5 pieces)
3. No. of guide frame (set)	4
4. Width (mm) x height (mm)	2,050 x 5,000
Design depth (mm)	
Pressure side	4,800
Anti. Pressure side	0
5. Sill level (m)	-1.00
6. Size of stop log piece	
width (mm) x height (mm)	2,250 x 1,000
7. Guide frame width (mm)	2,400

b. Method of Construction

(1) Fabrication

The gates and stop logs shall be manufactured as completely welded structures. The plates for the upstream faces shall be cut carefully to size, and where needed, be rolled to the specified radius. The side beams and horizontal beams shall be clamped tightly to the face plate, so as to ensure that, immediately before welding, the space between plate and members shall not exceed 1 m. Where members are welded to plates, welding shall be continuous on both sides, to ensure that no water or moisture can penetrate between the two parts.

(2) Installation

The Contractor shall install all mechanical installations as shown on the approved shop drawings, including all accessories such as anchor bolts, wall plates, guide rails and sills as far as necessary. All items to be embedded in concrete shall be supported rigidly and accurately before and while concrete is being poured. All aligning, supporting, etc., shall be done by the Contractor in accordance with good practice and the requirements of the Engineer. Base plates, wall plates, guide rails and sills shall be grouted afterwards if shown on the Drawings or if ordered by the Engineer. Grouting shall be performed by such methods as are approved by the Engineer and shall ensure a solid setting.

5.6.6 Electrical Equipment

This item shall consist of the following pieces of equipment.

No.	Name of Equipment	Specification	Quantity
1	Three-phase transformer	SRC-630/10/0.4	2 sets
2	High-voltage switchboard	ZSI 018	2 sets
3	High-voltage switchboard	ZSI 028	2 sets
4	High-voltage switchboard	ZSI 002	2 sets
5	Low-voltage switchboard	MNS-06	2 sets
6	Low-voltage switchboard	MNS-07	1 set
7	Low-voltage switchboard	MNS-94	2 sets
8	Low-voltage switchboard	MNS-46*46(Changed)	3 sets
9	Low-voltage switchboard	MNS-43*43*43*72	1 set
10	Low-voltage switchboard	MNS-43*(8)	1 set
11	Bench board	1000*900*1500	1 set
12	Soft start	PSD175	3 sets
13	Pump on/off control box	5*(LA-10-2K,AN)	1 set
14	Rotary bar rack cleaner control switchboard	7*(LA-10-2K,AN)	1 set
15	Motor gate hoist control switchboard	X51,500*650*250	1 set
16	Lighting /receptacle distribution box	XRM102-07-1	1 set
17	Ceiling fan	D800 Free	1 set
18	Fluorescent	HD5025	10 sets
19	1-pole switch	250V 5A	3 sets
20	Socket	250V 10A	2 sets
21	Enclosed switch	250V 5A	7 sets
22	3-pole switch	250V 10A	2 sets
23	Wall fitting	60W	8 sets
24	Water and dust proof overhead light	40W	7 sets

25	Lawn lamp	40W	5 sets
26	Cable	BV-500 2.5mm ²	220 m
27	Cable duct	1000*800	160 m
28	Lightning discharge wire	D8 Circle steel	65 m
29	Grounding electrode	50*50*5*2500	14 m
30	Earth wire	40*4	80 m
31	Electric pipe	G120	120 m
32	Electric pipe	G80	20 m
33	Electric pipe	G40	160 m
34	Electric pipe	G15	90 m
35	Power intake cable	YJV-10KV3*70	30 m
36	Power supply cable	VV-1KV 3*240+1*120	300 m
37	Power supply cable	VV22-1KV3*10+1*6	150 m
38	Power supply cable	VV1KV3*4+1*2.5	770 m
39	Power control cable	KVV-500 30*1.5	100 m
40	Power control cable	KVV-500 6*1.5	60 m
41	Power control cable	KVV-500 5*2.5	950 m
42	Power control cable	KVV-500 14*1.5	70 m
43	Metal trunking	100*200	25 m
44	Enclosed bus bar	Specially made	20 m

5.6.7 Tests and Inspections

Within three (3) months after the date of Notice to Commence and prior to the manufacture of the equipment, the Contractor shall submit five (5) copies of the Inspection and/or testing schedule to the Engineer for his approval. Tests and/or inspections shall include, but not limited to the items listed in Table 5.6.7-1.

Upon completion of the manufacture of the plant and at the time indicated on the work schedule, the Contractor shall conduct an operational test at the factory under actual field operating conditions. Pumps shall be operated to cover the full range of the operating condition. Testing method shall be in accordance with the requirements of JIS B 8301 and 8302 or other internationally accepted standards approved by the Engineer. Diesel engines shall be tested in accordance with the requirements of JIS B 8014 or other internationally accepted standards approved by the Engineer. Floodgates shall be inspected and tested in accordance with the Standards of Japan Water Gate Association or other internationally accepted standards approved by the Engineer and the requirements herein described. The results of all tests shall verify the technical particulars given in the approved documents and drawings.

Mill sheets shall be submitted for materials of impeller, shaft, bowl and discharge pipe of main drainage pumps and all other materials. Mill sheets are also required for SUS 304 material.

TABLE 5.6.7-1 FACTORY INSPECTION AND/OR TESTING SCHEDULE

Item	Required Tests/Inspection	Presence of Inspector Engineer or his Representative	Submission of Test Records
1. Main Drainage Pump	1. Performance	○ (at least one unit)	○
	2. Dimension	○ (ditto)	○
	3. Hydrostatic Pressure	×	○
	4. Material	×	○
2. Diesel Engine	1. Performance	○ (at least one unit)	○
	2. Dimension	○ (ditto)	○
3. Gear Box	1. No Load Operation	×	○
	2. Material	×	○
	3. Dimension	×	○
4. Discharge Pipe	1. Hydrostatic Pressure	×	○
	2. Dimension	×	○
	3. Material	×	○
5. Flap Valve	1. Dimension	×	○
	2. Material	×	○
6. Electric Panel	1. Sequence	○	○
	2. Dimension	○	○
7. Floodgate	1. Dimension	×	○
	2. Material	×	○
	3. Assembly	×	○
8. Auto Trash Rakes and Screens	1. Dimension	×	○
	2. Assembly	×	○
9. Belt Conveyor	1. Dimension	×	○
	2. Assembly	×	○
10. Hopper	1. Dimension	×	○
	2. Material	×	○
11. Small Pippings, Valves and Appurtenances	Manufacturer's Certificate	×	×

Notes: ○: Required ×: Not Required

5.6.8 Measurement and Payment

a. Method of Measurement

Each item of the mechanical equipment shall be measured by the unit or meter, except for the electrical equipment.

The electrical equipment shall be measured in lump sum.

b. Basis of Payment

The accepted quantities of mechanical equipment will be paid for at the contract unit price per each or meter or lump sum, complete and in place. This price shall be full compensation for fabrication, testing, delivery, installation, supervision and maintenance and for all labor, materials, tools, equipment and incidentals necessary to complete the works.

Payment will be made under:

<u>Item No.</u>	<u>Description of Work</u>	<u>Unit of Measurement</u>
I-4 (Area A)		
6-1*	Storm water pump (Φ 1,200mm \times 120m ³ /m \times 3.0m \times 90kW)	each
6-2*	Flap valve (Φ 1,200mm)	each
6-3*	Automatic raking machine (W2.0m \times H5.5m \times 2.2kW)	each
6-4*	Automatic raking machine (W2.0m \times H5.0m \times 2.2kW)	each
6-5*	Flood gate (sluice type, W2.0m \times H2.0m \times 6.0kW)	each
6-6*	Water level indicator	each
6-7*	Stop log (W2.25m \times H2.0m (5 pieces))	each
6-8*	PVC pipe for pumps	meter
6-9*	Electrical equipment	Lump Sum

Note: The items marked with * represent items that reappear repeatedly within the B/Q. Here only the item No. firstly appears is shown.

