

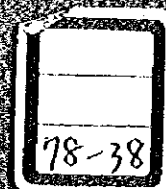
THE REPUBLIC OF THE PHILIPPINES

THE PASIG-POTRERO RIVER
FLOOD CONTROL AND SABO PROJECT

SPECIFICATIONS
FOR
CONSTRUCTION OF NO. 5 (TIMBU) SABO DAM

SEPTEMBER 1978

JAPAN INTERNATIONAL COOPERATION AGENCY



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SECTION I GENERAL

1.1 General

This Specification applies for construction of No.5 Sabo dam, and all work required by this Specification shall conform strictly to the accompanying "drawings". The Works are situated on the Timbu creek approximately 1 km upstream of the confluence of the Pasig-potrero main river and the Timbu creek.

1.2 Description of Works

The principal items of work to be executed under this Specification include:

- (1) All preparatory work for construction of No.5 Sabo dam.
- (2) All construction work for the concrete gravity main dam, including the sub-dam, apron and river bed protection work and etc.

1.3 Works Areas and Materials to be Furnished by the Contractor

- (1) The Contractor shall choose and acquire the works areas necessary for the office buildings, camps and other construction facilities at his own expense.
- (2) The Contractor shall furnish all materials required for the carrying out of the Works, and the cost of furnishing, hauling, storing and handling such materials shall be included in the unit prices for the various items tendered in the Schedules.
- (3) All materials that will become part of the completed works shall conform to this Specification. Where the requirements for any materials are not stated in this Specification, the materials shall conform with the appropriate and most recent international or national specification.
- (4) Materials furnished by the Contractor, which will become part of the completed works, shall be subject to inspection, examination and test when required.

1.4 Contractor's Construction Plant, Equipment and Facilities

The Contractor shall provide and operate the undermentioned plant, equipment and facilities at his expense for construction of the Works under the conditions specified hereinafter, and the cost

of providing, operating and maintaining all construction plant, equipment and facilities shall be included in the unit prices for the various items tendered in the Schedules.

1.4.1 Cement storehouse

- (1) Cement shall be stored in a damp-proof storehouse having a floor more than 0.3 meter above the ground.
- (2) Cement shall be stored in such a manner that the "first in" can be "first out".
- (3) The cement storehouse shall have a capacity of about 3-7 days in daily required quantity at least, and not more than 13 bags shall be permitted to be piled up, and this number shall be limited to 7 bags when the storage is expected to be longer than 60 days.

1.4.2 Aggregate stockyard

- (1) Aggregate shall be stored in the stockyard having a capacity of about 3-7 days in daily requirement of peak period.
- (2) The stockyard shall be well drained and be protected from strong direct sun rays.

1.4.3 Concrete mixing plant

- (1) The concrete mixing plant shall be the plant to weigh the materials and produce such a homogeneous concrete or mortar as required in this Specification.
- (2) The concrete mixing plant shall be located in a site closed to the dam site so as to facilitate transportation of the materials and concrete.

1.4.4 Electricity and air supply facility

- (1) Electricity supply facility shall have enough capacity to operate the whole electric driven machine and equipment simultaneously, and shall be provided with sufficient spare parts and materials to cope with electric trouble.
- (2) Air supply facility shall have enough capacity for the carrying out of the Works.

1.4.5 Water supply and drain facility

- (1) Water supply facility shall have enough capacity and head to carry out such works as cleaning work of the dam foundation, concrete manufacturing, concrete curing and etc.
- (2) Water drain facility shall have mobility and enough capacity to take care of water in the structure foundation in early time.

1.5 Payment

- (1) Payment for the preparatory works, materials, plant, equipment and facilities involved in Paragraph 1.3 and 1.4 will be made in accordance with monthly progress of the each work item of the "Works" in which their expense or cost are estimated.
- (2) No damages due to flood and others during construction period will be compensated except a case due to the cause construed as force majeure.

SECTION II CARE OF RIVER WATER AND DEWATERING

2.1 Care of River Water

The Contractor shall construct, install, maintain and operate all necessary closing dikes, flumes, channels, pumps and related protective works. He shall also furnish all materials required therefor. The cost of care of river water and dewatering shall be included in the lump sum price tendered in the Schedule.

- (1) River water shall be diverted to the outside of work area by the primary and secondary closing dikes according to progress of the works using such appropriate materials as hemp bags or vinyl bags filled with impervious soil.
- (2) Prior to beginning an excavation of dam foundation, the steel sheet piles will be driven at the upstream toe of the maindam as shown on the DRAWING.

2.2 Dewatering

- (1) The Contractor shall remove all water from and shall keep the excavations free of water while excavation, preparing foundations, and while placing concrete or as otherwise required for completing the Works.
- (2) For removal of water from foundations, surface running water shall be drained by means of the wooden flumes or other adequate means, and subsoil water shall be drained by providing the open channel and the drain pumps.
- (3) The open channel shall have proper slope and section enough to drain subsoil water with natural gradient to the downstream.

2.3 Payment

Payment for care of river water and dewatering will be made in accordance with percentage of work performed during the month.

SECTION III STEEL SHEET PILING

3.1 Material and Preparation

- (1) Steel sheet piles shall be of YSP-1 type or equivalent and length shall be not less than 10.0 meters.
- (2) For the piling work, an adequate engine driven driver with a cap shall be arranged.
- (3) For transportation of the steel sheet piles to the site, care shall be taken to prevent them from the damages such as bending, twisting and turning.

3.2 Driving

- (1) The steel sheet piles shall be driven in location as shown on the DRAWINGS. The top of each pile shall be at the elevation of the riverbed. The driven piles shall be remained as a part of the permanent structure.
- (2) Each pile shall be driven close to the centerline shown on the DRAWINGS so as to ensure perfect interlocking throughout the entire length of the pile.
- (3) Piles ruptured in the interlock or otherwise injured in driving shall be pulled out and shall be replaced by new piles. Should boulders be encountered, the Contractor shall make effort to drive the piles to the required depth, either by moving or shattering the boulder or he may be allowed to deviate the centerline of steel-piling with special care for connection of each portions.

3.3 Payment

Payment for furnishing and driving steel sheet piles will be made at the unit price per ton tendered therefor in the Schedule.

SECTION IV EARTHWORK

4.1 Clearing Works Area

- (1) The areas to be occupied by permanent structure shall be cleared of all trees, stumps, roots, bush, rubbish and other objectionable matter.
- (2) Materials from clearing operations shall be removed from the site of the work before the date of completion, or otherwise disposed of as approved.
- (3) The entire cost of clearing shall be included in the unit prices per cubic metre of excavation in open cut tendered in the Schedule.

4.2 Blasting

All blasting operations shall be carried out using the standard blasting warning code in the Republic of the Philippines. Protected detonators shall be used in all blasting operations done by electric firing. Blasting will be permitted only after adequate provisions has been made for the protection of persons, the works, and public or private property. Damages to the works or to public or private property by blasting shall be repaired by and at the expense of the Contractor.

4.3 Excavation in Open-cut

- (1) Excavation in open cut will be classified for measurement and payment as follows:
 - (a) Excavation, in common

Excavation in common is the excavation of all material that can be efficiently excavated with neither ripping nor blasting.
 - (b) Excavation, in rock

Excavation in rock is the excavation of all materials that cannot be efficiently excavated without blasting and ripping.
- (2) All open-cut excavation required for the permanent construction shall be made to the lines, grades and dimensions shown on the DRAWINGS.

- (3) All planking, strutting and supports necessary to retain the sides of the excavations shall be provided, erected and maintained in a safe condition by the Contractor.
- (4) If, at any point in excavation, material is excavated beyond the limits required to receive the structure, the additional excavation shall be solidly backfilled with concrete or other appropriate material at the expense of the Contractor. Provided that payment will be made only for overbreak due to the nature of the rock, and not due to the Contractor's action.
- (5) In excavation of the bottom and side slope upon or against which concrete is to be placed shall be excavated with care so as not to disturb the materials beneath or beyond the established excavation line.
- (6) Whenever an excavation approaches its final line and further blasting may injure the rock upon or against which concrete is to be placed, the use of explosives shall be discontinued leaving more than 1.0 m of rock, and excavation shall be completed by wedging, barring, channeling, broaching and other suitable methods.
- (7) After an excavation to the required lines of the structure foundation except rock foundation, excavated surface shall be compacted and consolidated with a tamper or other appropriate equipment so as to increase bearing strength of the foundation prior to concrete placing.
- (8) Payment for the various items of excavation in open cut will be made at the applicable unit prices per cubic metre tendered therefor in the Schedule. These unit prices shall include the entire cost of clearing, of blasting, of excavating and transporting the materials from the excavation to disposal. No payment will be made for the additional excavation due to flood and others during construction period except a case due to cause construed as force majeure.

4.4 Backfill

- (1) Materials to be used for backfill shall be the selected and suitable materials.
- (2) The Contractor shall place backfill to the locations where mentioned on the DRAWING. Backfill for non-overflow dam shall be placed on the backfill concrete.
- (3) Prior to place backfill, the site shall be cleaned and drained entirely, and the materials shall be placed in

approximately horizontal layers not more than 0.5 meter thick and moistened and thoroughly compacted.

- (4) Payment for backfill will be made at the unit price per cubic metre tendered therefor in the Schedule.

4.5 Disposal of Excavated Materials

- (1) Excavated materials that are unsuitable for or in excess of permanent construction requirements shall be wasted.
- (2) Waste piles shall be located at the upstream site from the dam site basically, but excavated materials from the open channel for subsoil water drain shall be wasted in the area of downstream right side terrace.
- (3) The cost of wasting of the materials removed in excavation shall be included in the various unit prices tendered in the Schedule for excavation.

SECTION V CONCRETE WORK

5.1 General

All concrete work shall be performed as established on the DRAWINGS and shall be carried out in the presence of an inspector.

5.2 Composition

5.2.1 Maximum size of aggregate

The maximum size of aggregate for any part of the work shall be the largest of the specified sizes the use of which is practicable from the standpoint of satisfactory consolidation of the concrete by vibration. The maximum size aggregate shall be as designated in Clause 5.2.2. If, for the Contractor's convenience, smaller maximum size aggregate is used, the resulting increase in the cement required shall be at the expense of the Contractor.

5.2.2 Mix proportions

- (1) The mix proportion and appropriate water-cement ratio will be determined on the basis of procuring concrete having suitable workability, density, impermeability, durability, and required strength, without the use of an excessive amount of cement.
- (2) The water-cement ratio of concrete shall not exceed 60 percent, by weight, for concrete in any structure.
- (3) Tests of aggregate and concrete shall be made by the Contractor, and mix proportions will be adjusted whenever necessary for securing the required properties of concrete.
- (4) The mix proportions contemplated to various types of structures are as follows:

Type of structure applicable	Type A Backfill concrete, main dam, sub-dam, apron, sidewall and riverbed protection block	Type B Surface concrete of both side walls and crest of maindam and subdam overflow section
Max. size aggregate (mm)	80	80
Water-cement ratio	< 60%	< 58%
Specific gravity of coarse aggregate	> 2.5	> 2.5
Slump at point of placement (cm)	5 ± 1	5 ± 1
Cement (kg)	185	215
Design strength (Kg/cm ²)	> 160	> 200

5.3 Cement and Admixture

5.3.1 Cement

- (1) For the permanent construction required by these specifications, bagged ordinary Portland cement shall be used for concrete and mortar, and shall be furnished by the Contractor.
- (2) Cement shall be stored in such a storehouse and a manner as prescribed in Clause 1.4.1.

5.3.2 Admixture

- (1) The Contractor shall furnish and use concrete admixtures so as to improve workability and finishability of concrete or mortar.
- (2) Admixtures will be accepted on the manufacturer's certification of compliance with specifications.
- (3) The Contractor shall use an approved water-reduction admixture in all concrete unless otherwise directed.
- (4) All costs incidental to the use of admixture shall be included in the unit prices tendered in the Schedule for applicable items for concrete in which the admixture is used.

5.4 Aggregate

5.4.1 General

- (1) Fine aggregate for concrete shall be taken from deposits near the dam site. Coarse aggregate for concrete shall be taken from the quarry site situated at north-west site of Dolores village in principle, but when quantity at the quarry site is insufficient, selected coarse aggregate from the riverbed may be used.
- (2) The raw materials from the deposits and the quarry site shall be processed at the aggregate plant. The processing shall include crushing and screening to produce fine and coarse aggregate meeting the requirements.

5.4.2 Fine aggregate

- (1) Fine aggregate shall be clean, hard, durable and of proper grading, and it shall be free from objectionable quantities of dirt, silt, organic matter or other deleterious materials. The moisture content of fine aggregate as delivered to the batching unit shall vary not more than 1.0 percent within any one hour, and not more than 3.0 percent within the working time of one shift.
- (2) The fine aggregate as batched shall be well graded and when tested by means of ASTM Standard Sieves shall conform to the following limits:

ASTM SIEVE NO.	INDIVIDUAL PERCENTAGE BY WEIGHT RETAINED ON SIEVE
4	0 to 5
8	5 to 15
16	10 to 25
30	10 to 30
50	15 to 35
100	12 to 20
Pan	2 to 8

The fineness modulus of sand shall range between 2.4 and 3.2.

- (3) The amount of deleterious substance in fine aggregate shall not exceed the limits prescribed below:

	<u>% by weight</u>
Clay lump	1.0
Material passing No. 200 sieve	3.0
Material retained on No. 50 sieve and floating on a liquid having a specific gravity of 2.0	0.5

5.4.3 Coarse aggregate

- (1) Coarse aggregate shall be clean, hard, durable and it shall be free from objectionable quantities of flat or elongated particles, organic matter or other deleterious material.
- (2) Grading of coarse aggregate shall be as follows:

Max. size of coarse agg. (mm)	<u>Grading (% by weight)</u>		
	<u>80-40 mm</u>	<u>40-20mm</u>	<u>20-5mm</u>
80	40-20	40-20	40-25
40		55-40	60-45

- (3) The amount of deleterious substance in coarse aggregate shall not exceed the limits prescribed in the following table:

	<u>% by weight</u>
Clay lumps	0.25
Soft particles	5.0
Material passing No. 200 sieve	1.0
Material floating on a liquid having a specific gravity of 2.0	1.0

5.5 Water

The water used in concrete and mortar shall be reasonably clean and free from objectionable quantities of silt, organic matter, alkali, salts, acids and other impurities.

5.6 Batching

- (1) Batching of cement, fine and coarse aggregates entering each batch of concrete shall be made by weighing measurement. The amount of water and admixture shall be determined by weighing or volumetric measurement.

- (2) The combined accuracy of batching equipment in feeding and measuring the material shall be within the following limits:

Water and admixture	1%
Cement and aggregate	3%

- (3) When the weighing unit is found out of order, the Contractor shall make necessary adjustment, repair and replacement immediately.

5.7 Mixing

- (1) The batched ingredients of concrete shall be mixed in a mechanical tilting batch mixer so as to produce a homogeneous mass of uniform consistency.
- (2) Unless otherwise directed or allowed, the mixing of each batch shall continue not less than 1.5 minutes after all ingredients, except the full amount of water and admixture, are in the mixer. Time of mixing shall be determined after mixer efficiency test.
- (3) Water shall be added before, during and after the mixer-charging operations. Excessive overmixing requiring addition of water to preserve the required concrete consistency will not be permitted. Concrete which has been retained in any mixer for more than 45 minutes after charging the mixer shall be wasted.
- (4) Mixers shall not be over-loaded by more than 10% of their rated capacity.

5.8 Placing

5.8.1 General

- (1) No concrete shall be placed until all formwork, installation of parts to be embedded, and preparation of surfaces involved in the placing have been completed.
- (2) Unless otherwise permitted, no concrete shall be placed in rain and standing water, and in no case shall concrete be placed in running water.

5.8.2 Preparation for placing

- (1) Immediately before concrete is placed, all surfaces of formation foundation to which concrete is to be bonded

shall be cleaned of oil, mud, organic matter, wooden pieces, objectionable coating, debris, loose rock fragment, or other perishable materials by effective means.

- (2) The surface of rock foundations shall be moistened thoroughly before placing concrete and standing water shall be removed.
- (3) The surface of soil foundation to which concrete is to be placed shall be free from standing or running water, wooden pieces or other objectionable materials above-mentioned. For soil foundation, the foundation shall be in damp condition before placing concrete.
- (4) The surface of construction joints upon or against which new concrete or mortar is to be placed shall be cleaned and damped by means. Cleaning shall consist of the removal of all laitance, loose or defective concrete, coating and foreign materials.

5.8.3 Temperature of concrete

Temperature of concrete when it is being placed shall be not more than 32°C. If concrete is placed when the weather is such that the temperature of the concrete would exceed 32°C, the Contractor shall employ effective means, such as precooling of mixing water, to maintain the temperature of the concrete, as it is placed, below 32°C.

5.8.4 Transportation

- (1) The method and equipment used for transporting concrete shall be such that concrete having the required composition and consistency will be delivered to the point of placement without objectionable segregation or loss of slump in excess of 2.5 centimeters.
- (2) Addition of water to concrete after it has been discharged from the mixer or "retempering" will not be permitted.
- (3) In case that concrete is transported by the following types of equipment, the equipment shall be installed and handled according to the following precautions.
 - (a) Concrete bucket. Bodies of concrete bucket shall be smooth and watertight. Covers shall be provided when needed for protection against rainfall.
 - (b) Chute. In general, transportation of concrete by the use of chutes will not be permitted unless approved.

The chute shall have a section with round corner and shall have a proper fixed slope so as to allow the concrete to flow easily and without segregation. The lower end of the chute shall be provided with a drop chute not less than 0.6 meters in height to avoid segregation of falling concrete. Chutes shall be protected from the direct rays of the sun.

- (c) Belt conveyer. Transporting concrete by belt conveyers will not be permitted unless approved. Belt conveyers shall be used with such precautions that belts are protected from rain, wind and sunlight, and that a proper hopper or vertical chute at least 0.6 meters in depth is used at the end of each conveyer.

5.8.5 Placing

- (1) After the surfaces have been prepared satisfactorily, surface of rock and construction joints of concrete shall be covered with a layer of mortar. The mortar shall be spread uniformly and concrete shall be placed immediately upon it.
- (2) Any concrete which has become so stiff that proper placing cannot be assured unless rettempered, or of which the slump has reduced by 2.5 centimeters or more shall be wasted to places designated, and shall be charged to the Contractor's expense.
- (3) Concrete shall be deposited in vertical dropping to minimize segregation and be placed so as not to strike hard against the forms assembled. The vertical free drop of falling concrete shall not exceed 1.5 meters.
- (4) All formed concrete shall be placed in horizontal layers continuously, the thickness of which shall not exceed 0.5 meter.
- (5) The height of one lift of concrete placing shall be as designated on the DRAWINGS or be within 0.6 meters to 2.0 meters.
- (6) Concrete shall be placed in continuous in a block or a lift so as to avoid cold joints where practicable. In the event of equipment breakdown, or if for any other reason continuous placing will be interrupted, the Contractor shall thoroughly consolidate the concrete at such joints to a reasonably uniform and stable slope while the concrete is plastic. The concrete at the surface of such cold joints shall be cleaned and shall be surface-dry as required for construction joints before being covered with fresh concrete.

- (7) Backfill concrete shall be placed at the places as designated on the DRAWINGS, and shall be placed simultaneously with the main structure concrete contacted.

5.8.6 Consolidation

- (1) Each layer of concrete shall be immediately consolidated with suitable appliances so that the concrete is compacted to the maximum practicable density and closes snugly against all surfaces of forms. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified.
- (2) In general, concrete shall be consolidated with electric or pneumatic power-driven, internal-type vibrators, operating at a speed of at least 7,000 revolutions per minute when immersed in concrete. The vibrating head shall be inserted in concrete vertically and at least 5 centimeters into the underlying layer. Where it is difficult to use internal vibrators, concrete may be consolidated with the external-type vibrator or compacted with the hand-plunger. The external-type vibrator shall be operated at a speed of 8,000 revolutions per minute and be large enough to effect consolidation.

5.9 Protection and Curing

- (1) The Contractor shall protect all concrete against injury or harmful effect due to sudden drying, loading, shock or vibration until it has hardened sufficiently to prevent damage. Exposed surface of all concrete shall be protected from the direct rays of the sun for at least the first 3 days after placement. All such protection shall be made effective as soon as practicable after placing of unformed concrete or after removal of forms from formed concrete.
- (2) Concrete shall be cured by water curing. Concrete cured with water shall be kept wet for at least 7 days immediately following placement of the concrete or until covered with fresh concrete. The concrete shall be kept wet by covering with water-saturated material or by any other method which will keep all surfaces to be cured continuously (not periodically) wet.

5.10 Payment

Payment for concrete in the various parts of the work will be made at the unit prices per cubic meter tendered therefor in the

schedule, which unit prices shall include the cost of finish applied to each item of concrete work. Payment will not be made for all wasted concrete or mortar, and for concrete required to be placed outside excavation paylines due to over excavation, or for any other reason.

5.11 Formwork and Finishes

5.11.1 General

- (1) Forms shall be used, whenever necessary, to confine concrete and shape it to the required line.
- (2) The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the pressure resulting from placement and vibration without deflection from the prescribed lines. The surfaces of all forms to be in contact with the concrete shall be clean, rigid, and sufficiently tight to prevent loss of mortar.
- (3) Edges at intersections of concrete surfaces that will be exposed permanently to view shall be beveled or rounded not less than 2 centimeters by the use of molding strips.
- (4) Immediately before concrete is placed, precaution shall be taken to see all forms are in proper alignment, and that all form supports are thoroughly secure and tight.

5.11.2 Material

Lumber used in the forms shall be sound, straight, free from warp, decay and loose knots and shall be dressed smooth and uniform in width and thickness prior to fabrication of formwork.

5.11.3 Construction tolerances

- (1) Variation in alignment, grade and dimensions of the structures from the established alignment, grade and dimensions shown on the drawings shall be within the tolerances specified in this clause. Concrete work that exceeds the tolerance limits specified herein shall be remedied or removed and replaced by and at the expense of the Contractor.
- (2) Construction tolerances for concrete construction
 - (a) Variation from the plumb, from specified batter, or from the surfaces of walls, vertical joint grooves and other conspicuous lines:

12 mm in 3 m

18 mm in 6 m

30 mm in 12 m or more

(In buried construction, double the tolerance.)

- (b) Variation from the level or from the grades indicated on the DRAWINGS in slabs, crests, slopes, horizontal joint grooves and other conspicuous lines:

6 mm in 3 m

12 mm in 10 m or more

(In buried construction, double the tolerance.)

- (c) Variation of the linear structure lines from established position in plan:

12 mm in 6 m

18 mm in 12 m or more

- (d) Variation of dimensions to individual structure features from established positions:

30 mm in 24 m or more

(In buried construction, double the tolerance.)

- (e) Variation in cross-sectional dimensions and thickness of slabs, walls, blocks and similar members:

Minus 5 mm

Plus 15 mm

5.11.4 Installation and preparation

- (1) Forms shall be installed so that the joint marks on concrete surfaces are in alignment both horizontally and vertically, and the joints between surfaces shall be smooth.
- (2) Before placing concrete, all forms shall be rigid and tight and shall be thoroughly cleaned, and all wooden chips, saw dust, dry mortar lumps, foreign matter and excess water shall be removed from between the forms. The forms shall be surface-treated with a commercial mineral oil.
- (3) Where forms for continuous surfaces are placed in successive lifts, care shall be taken to fit the forms tightly

over the entire surface so as to prevent leakage of mortar from the concrete to maintain accurate alignment of the surface.

- (4) Forms to be used more than once shall be maintained in serviceable condition and shall be thoroughly cleaned before being reused.

5.11.5 Embedded ties

Embedded ties for holding forms shall be so arranged that embedded tie shall terminate not less than 3 centimeters from the formed surface of the concrete after forms are removed where the maximum size of aggregate is 40 millimeters, and not less than 5 centimeters where the maximum size of aggregate is 80 millimeters.

5.11.6 Removal

Forms shall not be removed until the concrete has hardened and is of sufficient strength to carry its own weight safely, together with any construction loads likely to be imposed upon it. Forms shall be left, in general, for period not less than 36 hours for dams and walls. Care shall be taken in removing forms to prevent damage to the concrete.

5.11.7 Finishes and finishing

- (1) Surface irregularities which shall be distinguished from construction tolerances are designated "abrupt" and "gradual" for purposes of classifying finishes. Off-sets resulting from displaced, misplaced, or mismatched forms or loose knots in forms, or other similar form defects shall be considered "abrupt" irregularities. All other surface irregularities shall be considered "gradual" irregularities.
- (2) Formed surface
 - (a) Formed surfaces which will be covered by fill material or by concrete shall be required correction of surface irregularities only for depressions which exceed 25 millimeters.
 - (b) Formed surfaces which will be permanently exposed and where a reasonably attractive appearance is required including surfaces of dam slopes and inside surfaces of walls shall not exceed 6 millimeters for abrupt irregularities and 15 millimeters for gradual irregularities.

(3) Unformed surfaces

- (a) Finishing of unformed surfaces which will be covered by fill material or by concrete shall consist of sufficient levelling and screeding to produce uniform surfaces. Surface irregularities shall not exceed 25 millimeters.
- (b) Unformed surface applied floated finish such as dam and overflow crest, surfaces of apron and tops of walls shall not exceed 6 millimeters for abrupt irregularities and 15 millimeters for gradual irregularities.

5.11.8 Damaged or defective concrete surface

- (1) Defective concrete and concrete damaged from any cause shall be removed and replaced with acceptable concrete by the Contractor at his expense. Irregularities of alignment due to inaccurate finishing of surfaces, bulging of forms, or other defects shall be rectified by and at the expense of the Contractor.
- (2) All porous and fractured concrete and surface concrete, to which additions are required to bring it to prescribed lines, shall be removed by chipping openings into the concrete. The chipped openings shall be sharp-edged and keyed and shall be filled to the required lines with fresh concrete or dry patching mortar. Where concrete is used for filling, the chipped openings shall be not less than 8 centimeters in depth and the fresh concrete shall be reinforced and dowelled to the surface of the openings.
- (3) Mortar for patching shall consist by volume of one part of cement, two parts of regular concrete sand, and just enough water so that after thorough mixing of the ingredients the mortar will barely hold together when compacted by squeezing with the hand. The mortar shall be fresh when placed, and immediately prior to mortar application, the surface to which the mortar is to be bonded shall be dampened.
- (4) In repairing damaged or defective concrete at important locations, the Contractor shall use epoxy resin bonding agent if required.
- (5) All patches and repairs shall be kept continuously damp for a period of not less than 7 days and kept out of the direct rays of the sun for at least 7 days immediately following completion of the patch or repair.

5.11.9 Payment

Payment for forms will be made for the area of forms actually brought in contact with placed concrete and at the unit price per square meter bid therefor in the schedule. Forms used to fill over-excavation shall be at the expense of the Contractor.

SECTION VI SPECIAL CONCRETE REQUIREMENTS

6.1 Contraction Joints

- (1) Contraction joints shall be located and constructed at the places where shown as the construction joints on the DRAWINGS for the purpose of construction process. The joints shall be made by forming the concrete on one side of the joint and allowing it to set before concrete is placed on the other side of the joint.
- (2) The cost of construction joints shall be included in the unit price tendered therefor in the schedule for the concrete in which the joints are required.

6.2 Waterstops

6.2.1 General

Plastic waterstop, 300 mm wide, shall be placed in contraction joints of dams at 50 centimeters from and along the upstream slope surface of dam. The waterstops shall be of extruded polyvinyl chloride complying with JIS K6773-1977, or equivalent.

6.2.2 Storage and installation

- (1) All waterstop shall be stored in such a way that the material does not deteriorate during storage.
- (2) All field splices of waterstop shall be made so as to provide watertight connections by such means as specified by the manufacturer.
- (3) The Contractor shall provide suitable supports and protection during the progress of work to protect the waterstop from damage, deterioration, or wrapping.
- (4) Waterstop shall be installed with equal widths of the material embedded in the concrete on each side of the joint. The concrete shall be carefully placed and vibrated around the waterstop for a complete bond between the concrete and all embedded areas of the waterstop.

6.2.3 Payment

Payment for furnishing and placing waterstop will be made at the applicable unit prices per linear meter, in place with no allowance made for laps at splices, bid therefor in the schedule.

6.3 Drainage Holes

- (1) Hume pipes, 300 millimeters of inside diameter, 30 millimeters of thickness and 2000 millimeters in length, shall be installed for the drainage holes of main dam at the places where designated on the DRAWINGS.
- (2) Concrete surface at where the pipes are to be placed shall be levelled evenly so as to place the pipes to the prescribed lines and level.
- (3) Joints of pipes shall be connected with an appropriate cover so that any mortar will not leaks in the pipe during successive concrete placing on the pipe, and should any pipe become clogged or obstructed from any cause, it shall be cleaned out or replaced by and at the expense of the Contractor.
- (4) Payment for furnishing and placing pipe will be made at the unit prices per linear meter tendered in the schedule.

SECTION VII RIVERBED PROTECTION

7.1 General

Downstream river bed surface of the sub-dam shall be protected with the concrete blocks, 3.0 m in length, 2.0 m in width and 2.0 m of thickness, as shown on the DRAWING.

7.2 Excavation and Concrete Placing

- (1) Excavation works of the riverbed shall be carried out in compliance with Paragraph 4.3 to the level designated on the DRAWING.
- (2) Immediately before concrete is placed, all surfaces of formation foundation to which concrete is to be placed shall be levelled and be free from standing or running water, wooden pieces or other objectionable materials.
- (3) Concrete works shall be carried out in compliance with SECTION V.
- (4) Concrete of all the blocks shall be placed uniformly to keep the level designated on the DRAWING.
- (5) Concrete blocks shall be connected longitudinally and laterally by hooked iron bars of 25 mm diameters as shown on the DRAWING.
- (6) Spaces of each block and of between the blocks and sub-dam shall be filled with cobbles compactly to the top surface of blocks.

7.3 Payment

Payment for concrete including furnishing and placing iron bars and for fill cobble will be made at the unit prices per cubic meter tendered therefor in the schedule. Payment for forms will be made for the area of forms actually brought in contact with placed concrete and at the unit price per square meter tendered therefor in the schedule.

