

SECTION VI

STRUCTURE EXCAVATION

601 SCOPE

Structure Excavation includes the removal of all materials within the structure lines including necessary dewatering operations not otherwise specified. It shall also include additional excavations within the vicinity of the structure in order to shape the ground as shown on the Drawings or as directed by the Engineer.

602 CLASSIFICATION

Structure excavation shall be classified in accordance with paragraph 402.

603 CONSTRUCTION REQUIREMENTS

All excavation requirements described in paragraph 403 are applicable under this Section.

604 METHOD OF CONSTRUCTION

All structures, where practicable shall be constructed in open excavation. The method of construction or excavations shall be in accordance with the applicable provisions of paragraph 404 and the following requirements.

Foundations shall be excavated according to the outline of the footings and floors of structure as shown on the Drawings or as directed by the Engineer, and shall be of sufficient size to permit free movement of workers.

On excavation of common materials the foundation bed upon which structures are to be placed shall be finished accurately to the established lines and grades after a thorough compaction and trimming of the foundation with the use of suitable tools and equipment. As soon as the foundation excavations have been trimmed to their final level, it should be protected from degradation by weathering. Should the foundation material soften through exposure then the soft material shall be removed and replaced at the Contractor's expense. If at any point, material is excavated beyond the lines and grades of any part of the structure, the over-excavation shall be filled with selected materials approved by the Engineer and shall be placed in layers of not more than 20 centimeters thick, moistened and thoroughly compacted by special roller, mechanical tampers or by other approved methods. A density not less than 90% of the maximum dry density determined by ASTM test D-698 is required. The cost of filling over-excavation ordered by the Engineer shall be borne by the Contractor.

On excavation of rock materials, the bottom and side surfaces of excavated rock excavation upon or against which concrete and weep holes are to be placed shall conform to the required grades and dimensions as shown on the drawings or as established by the Engineer. If at any point, materials are excavated beyond the required limits, the over-excavation shall be filled with concrete at the expense of the Contractor including the cost of all materials required.

When concrete is to be placed upon or against rock, the excavation shall be of sufficient depth to provide for the minimum thickness of concrete at all points and any deviation from the required minimum thickness of concrete shall be avoided as much as possible. The surface on which concrete will be laid shall be trimmed and thoroughly cleaned as directed by the Engineer.

When excavation of rock materials reaches the surface upon or against which concrete is to be placed, blasting shall be stopped and the remaining mass of rock shall be carefully removed by means of jack-hammer or any appropriate hand tool. The point beyond which blasting will not be allowed shall be determined by the Engineer. All damages to the rock foundation caused by improper blasting operation shall be repaired by the Contractor at his own expense in a manner acceptable to the Engineer.

All foundations for bridge pier footings shall be excavated to such depths as may be necessary to secure stable bearing for the structure. Whenever the safe bearing power of the soil as uncovered is less than that called for on the Drawings, pilings or appropriate spread footings will be used. The elevations of the bottoms of footings, as shown in the Drawings shall be considered as approximate, and the Engineer may order, in writing, such changes in elevations and dimensions of footings as may be necessary to ensure a satisfactory foundation. Bearing tests, upon written order of the Engineer, shall be taken to determine the supporting power of the soil. Cost of bearing test will be paid as "Extra Work".

If, in the opinion of the Engineer, the material at the base of the excavation is unsuitable for foundation he shall instruct the Contractor to either a) Carry out additional excavation to a depth of 50 cm. below the proposed bottom of concrete shown on the Drawings and to maximum depth of 60 cm. outside of the outermost lines of said base and replace with backfill compacted to at least 90% of the maximum dry density or b) strengthen the soft material by ramming in gravel and cobbles until a firm foundation is obtained. Measurement and payment for the backfill shall be made under Section XII, "Structure Backfill".

605 METHOD OF MEASUREMENT

Structure Excavation shall be measured by the cubic meter in its original position before being excavated in accordance with the Drawings, or as may be ordered by the Engineer. No excavation beyond the paylines shown on the Drawings will be measured for payment. For canal structures, the limit of measurement along the lines perpendicular

to the flow of water shall be the vertical planes at the outer edges of the inlet cut-off walls. The upper limits of the solid measured for payment shall be the canal bottom for canal structures or the original ground surface in case of diversion structures. The lower limit shall be the bottom of the required excavation. Excavated materials not vertically above the boundaries as specified above shall not be measured for payment. The volume measured shall not include water and other liquids removable by pumping. Such materials as mud, muck, quagmire and other similar semi-solids not removable by ordinary pumping shall be considered pay quantities and shall be measured and paid for as "Structure Excavation".

However, in case structure excavation for canal structures is done before canal excavation, the upper limit of the solid measured for payment shall be the original ground surface in accordance with the structure excavation paylines.

606 BASIS OF PAYMENT

The volume measured as provided above will be paid per cubic meter, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, equipment, tools and incidentals and subsidiary works necessary to complete the work described under this Section.

For diversion works, canal siphons and bridge structure excavations, the cost of dewatering operation unless otherwise specified in the Bill of Quantities shall be paid under a separate item in the Bill of Quantities. For all other structure excavations, dewatering operations involved are considered subsidiary works and the cost thereof shall be considered included in the unit price of structure excavation.

The Contractor shall be paid sixty percent (60%) of the pay quantities of the actual excavation acceptably accomplished in accordance with the paylines as shown on the Drawings or as directed by the Engineer. The remaining forty percent (40%) will be paid upon pouring of concrete for the foundation or upon placing of riprap, gravel blanket or grouted riprap in accordance with the Drawings and Specifications.

SECTION XII

STRUCTURE BACKFILL

1201 SCOPE

The work under this Section shall include hauling (if necessary) and backfilling with suitable materials taken either from Structure Excavation, Canal Excavation, Side Borrow or Borrow Haul all spaces excavated and not occupied by the structure and spaces between the natural ground surface and the finish lines indicated to be filled and all other sections directed to be filled by the Engineer, all in accordance with these specifications and in conformity with the lines, grades and dimensions shown in the Drawings or as ordered by the Engineer. It shall also include the dewatering and removal of all unsuitable materials as ordered by the Engineer from the spaces to be backfilled or filled.

1202 METHOD OF CONSTRUCTION

All spaces to be backfilled or filled shall be cleared of all rubbish and other objectionable matter. The excavation pit to be backfilled shall be dewatered and all mud and loose materials shall be removed before backfilling. The filling materials, with the proper moisture content determined by the Engineer, shall be deposited loose and in layers not exceeding 30 centimeters and then thoroughly compacted by ramming, rolling or by means of mechanical tampers or portable vibratory compactors to obtain at least 85% compaction behind bridge abutments, retaining walls, cut-off walls and immediately above pipes, box or barrel conduits and gradually increasing to at least 90% compaction up to the surface of the roadway in the case of approaches to bridges, Road Crossing or Culvert Structures. The time when to start backfilling operation shall be determined by the Engineer.

The compacted backfill above pipes, barrels and other conduits, shall be brought at least 60 centimeters before any compacting equipment utilized in embankment construction shall be used or allowed to pass. Additional layers above 60 centimeters can be completed by the use of roller type compacting equipment employed in embankment compaction.

Materials for structure backfill shall be as described in Paragraph 902 (c).

1203 METHOD OF MEASUREMENT

Structure backfill shall be measured in cubic meters in its final compacted and uncompacted position within the limits of structure excavation paylines and surfaces of concrete in contact with the backfilled material as shown on the Drawings or as directed

by the Engineer. Volumes occupied by the structure and other features will not be included.

1204 BASIS OF PAYMENT

Structure Backfill will be paid for at the contract unit price per cubic meter, which price and payment shall constitute full compensation for side borrow, borrow haul and overhaul operations and for furnishing all labor, equipment, tools and all incidentals and subsidiary works necessary for the successful completion of the work under this Section.

For newly constructed Drainage Culvert, the volume between the original ground surface and the top of the canal embankments is part of the embankment construction operation and therefore shall not be included for payment under this Section (which payment shall be included under embankment construction and compaction).

SECTION XVI

CONCRETE DEMOLITION WORK

1601 SCOPE

The work under this Section shall include demolition, removal and disposal in a manner approved by the Engineer of all portions of the existing structures indicated to be demolished, all in accordance with the Drawings and these Specifications. All other objectionable materials shall be disposed off to the designated disposal areas as ordered by the Engineer.

1602 METHOD OF CONSTRUCTION

Contractor shall submit for approval his proposed plans and operations for undertaking the demolition of structures. The proposed plans shall show details of the proposed method of demolition, removal and disposal of materials, blasting, drilling, and other devices the Contractor may propose. The work shall conform to the lines and grades as shown on the Drawings, or as directed by the Engineer. In cases of modification or renovation of an existing concrete structure where partial demolition or chipping on the surfaces of existing structure may be required, Contractor shall perform his chipping or demolition operation in such a manner as to avoid chipping or over demolition or damage of the entire structure. Over chipping or over demolition or entirely damage structures shall be restored at the expense of Contractor in a manner satisfactory to NIA.

1603 METHOD OF MEASUREMENT

Concrete demolition of existing structures will be measured by the number of cubic meter in its original position before demolition. Measurement will be made only to acceptably demolished structures with all materials disposed off to designated disposal areas. No material demolished by Contractor beyond the lines and grades indicated on the Drawings will be included for measurement unless additional demolition has been previously authorized by the Engineer in writing.

1604 BASIS OF PAYMENT

Concrete demolition of existing structures measured as provided above shall be paid for at the contract unit price per cubic meter, which price and payment shall constitute full compensation for furnishing labor, supplies, tools and equipment and other incidentals or subsidiary works necessary for the successful completion of the work described under this Section.

SECTION XVII

CONCRETE STRUCTURES

1701 SCOPE

The Contractor shall construct all concrete structures shown on the Drawings.

Concrete shall be proportioned, mixed, placed, finished and cured as specified in Section XV, Concrete, except as modified herein. The sequence of construction of the structures shall be subject to the approval of the Engineer. Where the thickness of any portion of a concrete structure is variable, it shall vary uniformly between the dimensions shown. Cement mortar plastering is not allowed in the construction of structures, unless otherwise specified elsewhere in these Specifications.

1702 CONCRETE CONSTRUCTION

All concrete construction shall conform to the provisions of Section XV, Concrete and the detailed requirements of the following paragraphs. Concrete finished shall conform to Paragraph 1519 and/or shall be as noted on the Drawings.

All structures shall be built to the specified lines, grades and dimensions. The location of all construction joints shall be shown on the Drawings or as approved by the Engineer. Construction joints shall be constructed as shown on the Drawings. The Contractor shall place and embed or attach to each structure all timber, metal or other accessories necessary for its completion as shown on the Drawings or as directed by the Engineer.

The dimensions of each structure shown on the Drawings will be subject to change as may be found necessary by the Engineer to adopt the structures to actual field conditions and conditions disclosed by excavation.

1703 METHOD OF MEASUREMENT

Measurement for payment of any and all classes of concrete will be made by the number of cubic meter computed to the neat lines of the structure, unless otherwise specifically shown on the Drawings or specified in these Specifications. In the event cavities resulting from careless excavation or from excavation performed to facilitate the Contractor's operations, as determined by the Engineer, are required to be filled with concrete. Such refilling will be made by at the expense of the Contractor. In measuring concrete for payment, the volume of all openings, embedded pipes, woodwork and metal work within the concrete will be deducted.

1704 BASIS OF PAYMENT

Payment for any and all classes of concrete in various parts of the work will be made at the applicable contract unit prices per cubic meter which price and payment shall include cost for furnishing all materials, equipment and labor, and all operations required in the construction as specified under Section XV, Concrete, except that payment for reinforcing bars and joint materials will be made at the applicable separate contract unit prices in the Bill of Quantities.

If during the implementation of the project, the sources of aggregates differ from those chosen by the Contractor considered in the derivation of his unit bid price for concrete, the Contractor shall not be entitled to any claim for unit price adjustment as a result of such alteration of sources.

1705 CONCRETE FOR ALL STRUCTURES

(a) General

The item "Concrete for All Structures" in the Bill of Quantities include all concrete in diversion works (except Rubble Masonry), canal structures and road structures such as siphons, bridges, drainage culverts, road crossings, pipe crossings, ungated thresher crossings, control structures, drop structures, headgates and turnouts and all other structures not otherwise specified elsewhere in these Specifications.

Small concrete structures, at the option of the Contractor, may be installed as precast units provided that precast structures installed in place are equal in all respect to cast-in-place construction as specified in these specifications.

Concrete for diversion works, canal structures and other structures will be measured and paid for as specified in Paragraphs 1703 and 1704, respectively. Structures not fully and acceptably completed will not be measured for payment. Precast structures installed and acceptably completed in place shall be paid for as specified in Paragraph 1704.

All materials used like cement, admixtures, aggregates and steel reinforcing bars shall conform to the provisions of Section XV, Concrete and Section XXIII, Reinforcing Steel Bars, respectively. Classes of concrete to be used shall be those specified in the Drawings.

(b) Curing and Joints

All concrete shall be cured in accordance with paragraph 1522, except that concrete for canal siphon shall be cured until the concrete test cylinders shall have attained a strength of at least 210 kg. per square cm. (3,000 pounds per square inch).

The Contractor shall construct expansion and construction joints at sections specified on the drawings all in accordance with the provisions of paragraph 1517 and Section XXI, Concrete Joints and Joint Materials, and elsewhere in these Specifications.

1706 PRE CAST CONSTRUCTION

(a) Scope and Description

Pre-casting of reinforced concrete may be resorted to as an alternative to poured-in-place concrete for certain structures such as headwalls and collars, parshall flumes, turnouts, division boxes, and other structures. Should the Contractor choose to employ pre-cast construction on these structures, he must so inform the Engineer in writing, submitting in detail his proposed design, modifications of concrete sections, concrete specifications, reinforcements and schemes of construction of all pre-cast units. The NIA may further required the Contractor to submit all other additional informations as may deemed necessary.

The NIA may approve the construction proposed on precasting of concrete with or without correction. The approval, however, does not relieve the Contractor of any responsibility if such work does not meet specified results.

Reinforced concrete pipes and concrete hollow blocks are not considered pre-cast construction, hence, are excluded under this Section.

(b) Transporting and Placing

Extreme care should be observed in handling, storing, moving and erecting to avoid cracking, twisting, or other distortions that would result to cracking or damage to the precast concrete. Pre-cast concrete members shall be handled, transported and erected in an upright position and the points of support and directions of the reactions with respect to the members shall be approximately the same as when the member is in final position.

(c) Sampling and Testing

The individual components of precast concrete structures, shall conform to the applicable provision of Section XV, Concrete and will be subject to the usual test for reinforced concrete.

(d) Measurement and Payment

Measurement of concrete in pre-cast structures will be measured by the number of cubic meter. It shall be computed to the neat lines as if these structures were constructed to the details shown on the Drawings.

The Contractor will be paid for all pre-cast structures acceptably installed or completed in place. He shall be paid for each pre-cast unit as if the units were constructed to the details shown on the Drawings, regardless of the actual dimensions of the pre-cast unit.

1707 LEAN CONCRETE

In the construction of siphons, the bottom of the cast-in-place concrete barrels will be exposed to high velocity flow of seepage during pouring which will absorb or wash out the cement in the concrete poured. To minimize the effect of seepage, a blinding concrete with minimum strength of 70 kg/sq. cm. shall first be poured to the lines, grade and dimensions on which the barrels will be constructed as shown on the Drawings.

Lean concrete shall be measured and paid for as specified in paragraphs 1703 and 1704, respectively.

1708 STAFF GAGES

The Contractor shall install two vertical staff gages, one upstream and one downstream, in all parshall flumes and turnouts with valve structures and in all check structures in the laterals as shown on the Drawings or as directed by the Engineer. The porcelain plated or enameled steel staff gages and other materials and accessories necessary for the installation shall be supplied by the Contractor.

Installation of staff gages will not be measured for payment including all the channels, anchors, anchor bolts and other metal materials necessary to install the staff gages at the parshall flumes and check structures. The cost of installation and other materials supplied by the Contractor shall be included in the contract unit price for concrete in the respective structure where gages are required.

SECTION XIX

RUBBLE MASONRY

1901 SCOPE

The work under this Section shall include furnishing all materials, supplies, tools and equipment; construction of all necessary form work; placing rubble stone and concrete binder on an approved foundation and form work; the removal of forms and curing of the rubble masonry, all in accordance with the Drawings and these Specifications or as directed by the Engineer.

1902 MATERIALS

Rubble stones shall consist of field stones that are clean, sound, durable, resistant to the action of water, and must have specific gravity of at least two and six tenths (2.6), and diameters ranging from 15 centimeters to 60 centimeters, sixty per cent (60%) which comprises the bigger sizes. Stones shall have the prior approval of the engineer before their use. Materials for concrete binder shall be in accordance with the applicable provisions of Section XV. Concrete binder shall be Class "A" concrete with 37.50 millimeters maximum size of aggregates.

1903 METHOD OF CONSTRUCTION

Preparation and handling of the concrete binder shall be in accordance with Section XV. The stones shall be thoroughly wet before they are installed in place. The entire surface of every stone shall be thoroughly covered with concrete binder. In general, one cubic meter of rubble masonry will require one-half cubic meter of concrete binder. Actual variation in this proportion will not entitle the Contractor to any price adjustment. It is expected that the whole rubble masonry especially in the case of dam and apron as well as other structures should be well encased and covered by the concrete so that it forms the hearting of the body of dam and apron and will act contiguous with the concrete shell. This can be achieved by tamping the stones into the concrete using heavy wooden blocks handled by one or two people. After the bed has been prepared as required the first layer of mortar should be laid and rubble embedded in them. The thickness of mortar should be such that each rubble could be embedded at least 50 % of its longest dimension in the mortar so that when the next layer of mortar is poured the rubble which has been embedded is not disturbed. The next layer of boulders can be arranged in the mortar now placed following the same procedure. This will ensure that all the boulders are fully covered with mortar and they are well entrenched and stable in the mortar so that they are not disturbed when subsequent layers of mortar stones are poured. The stones shall be well set such that no stone will project beyond the lines indicated on the Drawings. The concrete binder shall be properly worked into the spaces between

stones so that no void is left within the rubble masonry. In case reinforcements are placed, no stone shall be closer than four inches (10 centimeters) to the nearest reinforcing bars. Rubble masonry shall be cured by water for five days.

The general construction procedure should be always to start from lowest elevations so that the sub-grade on which the concrete is laid is not disturbed by the seepage forces when the higher layers are excavated and prepared for concrete pouring.

In situations where rubble masonry is directly constructed on the sub-grade, the sub-grade should be prepared exactly as for any other concrete structures. In these cases, also the first layer can consist of concrete of 15 centimeters thickness in the case of minor structures and 20 centimeters in the case of major structures. The concrete manufacture etc. will be as specified under Section XV and the strength will be as of Class "A" concrete.

1904 METHOD OF MEASUREMENT

"Rubble Masonry" will be measured in cubic meters in its final position based on the neat lines of the structure as shown on the Drawings.

1905 BASIS OF PAYMENT

The volume measured as provided above will be paid at the contract unit price per cubic meter, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, tools, equipment and all incidentals or subsidiary works necessary for the successful completion of the work described under this Section.

SECTION XXIII

REINFORCING STEEL BARS

2301 SCOPE

All reinforcing steel bars required for the works as detailed in the Construction Drawings or as directed by the Engineer shall be furnished by the Contractor.

The work under this Section includes the hauling of all reinforcing steel bars required for the works to the project site, storing, cutting, bending and proper placing, all in accordance with the drawings and these Specifications.

The length for each size of reinforcing steel bar to be furnished by the Contractor shall be computed by taking the theoretical length of steel bars shown on the drawings multiplied by 1.07 to get the approximate length required for the work. All reinforcing steel bars shall be furnished in commercial standard lengths and the Contractor shall cut and bend the reinforcing steel bars to the detail and dimensions shown on the Drawings.

2302 MATERIALS

All reinforcing steel bars to be furnished by the Contractor shall be Grade 40 or PS 275, deformed type and conforming to the requirements of ASTM A-615. The nominal dimensions and unit weights of bar designation shall be in accordance with the following table:

Nominal Bar Diameter	Unit Weight (kg/m.)	Nominal Dimensions	
		Cross Section Area (sq.mm.)	Perimeter (mm.)
6 mm.	0.222	28.27	18.85
8 mm.	0.395	50.27	25.13
10 mm.	0.616	78.54	31.42
12 mm.	0.888	113.10	37.70
16 mm.	1.579	201.10	50.27
20 mm.	2.466	314.20	62.83
25 mm.	3.854	491.90	78.54
28 mm.	4.833	615.75	87.96
32 mm.	6.313	804.25	100.53
36 mm.	7.991	1,017.90	113.10

The nominal diameter of a deformed bar is equivalent to the diameter of a plain bar having the same weight per unit length of the deformed bar.

2303 CONSTRUCTION REQUIREMENT

Workmanship shall be at the highest grade and shall be in accordance with the latest standard practice of the industry.

1. **Cutting and Bending.** Cutting and bending of reinforcing bars may be done in shop or at the job site. All bending works shall be in accordance with the latest standard practice and by approved machine methods. Radii for bends and hooks will be specified on the approved detailed reinforcement Drawings in accordance with sound design procedures.

2. **Placing.** Reinforcement shall be laid, anchored and embedded in the concrete as shown on the Drawings or as directed by the Engineer. Unless otherwise directed, the spacing of reinforcement bars shall be measured along the center line of the bars. Reinforcement shall be inspected for compliance with requirements as to size, length, splicing, position and number after placement based on the approved reinforcement drawings.

Before reinforcement are placed, the surfaces of the bars and the surfaces of any metal bar support shall be cleaned of heavy flaky rust, loose scales, dirt, grease or other foreign substance which, in the opinion of the Engineer, are objectionable. Heavy flaky rust that can be removed by firm rubbing with burlap or equivalent treatment is considered objectionable. After being placed, the reinforcing bars shall be maintained in a clean condition until completely embedded in concrete.

Reinforcing bars shall be accurately placed and secured in position so as to avoid displacement during the pouring of concrete. Special care shall be exercised to prevent any disturbance of the embedded reinforcement during the setting of concrete. Metal chairs, hangers, spacers or other approved support may be used by the Contractor for supporting reinforcing bars. Metal supports shall be galvanized when they are to be exposed to view on completed concrete surfaces or where it is use will contribute in any way to the discoloration or deterioration of the concrete.

3. **Relation of Bars to Concrete Surfaces.** The minimum cover for all reinforcements shall conform to the dimensions shown on the detailed reinforcement Drawings.

4. **Splicing.** All splices in reinforcement shall be as shown on the Drawings or as directed by the Engineer. The lapped ends to bars shall be either supported sufficiently to permit the embedment of the entire surface of each bar in concrete or shall be securely wired.

5. **Welding.** Welding of bars shall be performed only where shown on the Drawings or as authorized in writing by the Engineer and shall conform to the

requirements of AWS: D12.1, latest revision. All welders employed shall show proof of their welding qualifications to the Engineer. All welding shall be done using metal arc welding, pressure gas welding, submerged arc welding or thermit welding. All electric shall be acceptable to NIA. Coverings of low hydrogen electrodes must be thoroughly dry when used. The surfaces to be welds shall be clean and shall be free from rust and dirt. All welds shall develop the full strength of the bar or the smaller bar when two different sizes are welded. Test will be required of not more than five percent of the welds. Approved testing equipment for testing welds shall be furnished by Contractor.

6. **Protection.** Reinforcement to remain exposed and intended for future concrete embedment shall be protected from corrosion or other damages in an approved manner where directed. The reinforcement protection shall be of such nature that it can be thoroughly cleaned without difficulty prior to encasement in concrete.

2304 PREPARATION OF REINFORCEMENT DRAWINGS

Contractor shall submit for the approval of NIA detailed reinforcement drawings in accordance with Article GC-47. These drawings will include bar-placing drawings, bar bending drawings, bar list, and any other reinforcement drawings as may be required to facilitate placement and checking of reinforcing bars. No work shall be done by contractor until such approval has been secured from NIA.

The Reinforcement Drawings submitted shall show the name of the structure location by stationing where the reinforcement drawings is intended and all the necessary informations required by NIA. It shall likewise bear the stamp or seal of Contractor as evidence that the Drawings have been checked by Contractor.

Contractor shall be held responsible for any delay in the progress of the work occasioned by his failure to observe the requirements and the time for the completion of the contract will not be extended on account of his failure to promptly submit said drawings in strict adherence herewith.

2305 SAMPLING FOR TESTING AND ACCEPTANCE OF MATERIALS THAT FAIL TO MEET CONTRACT REQUIREMENTS (FOR STEEL BARS FURNISHED BY CONTRACTOR)

Sampling of reinforcing steel bars furnished by the Contractor for incorporation in the Permanent Works shall be carried out by NIA at the manufacturer's stockyard before delivery to the project site. The NIA authorized representative shall, at random, take two representative samples of reinforcing steel bars per lot covered by the manufacturer's mill certificate. A lot shall consist of all steel bars of the same heat or blow as shown in the mill certificate, and the same nominal cross-section and grade. Samples shall be tested at the manufacturer's testing laboratory, if any, or to any approved Government testing laboratory at Contractor's expense. A lot or lots represented by samples tested which failed to meet specified requirements shall be

rejected and will not be counted for delivery to the project site. Sampling and testing shall be in accordance with ASTM requirements. All deliveries shall be subject to prior approval of NIA.

The NIA reserves the right to accept steel bars that fail to meet the contract requirement provided that the deficiency is not more than nine percent (9%) of the requirement per each type of test and provided further that a corresponding reduction in the unit price will be made. The percentage of reduction equal to the percentage of deficiency based on the minimum requirement of the ASTM A-615 Standard. For example, if the value of the test result for one type of test is five per cent (5%) below the minimum requirement, the unit price for payment will be reduced by 5%. If the non-compliance with the test requirements is on two or more tests, the price reduction will be the summation of the percentage of the deficiencies.

2306 METHOD OF MEASUREMENT

A. Furnishing and Stockpiling

Measurement for payment for the furnishing and stockpiling of reinforcing steel bars shall be made on the actual deliveries to the project site and after presentation of the following documents:

- a) Delivery receipt duly acknowledged by the Engineer and the Project Auditor or their duly authorized representatives
- b) Manufacturer's certificate showing the details of manufacture, composition and physical properties of the steel bars.
- c) Certificate of acceptance by the Engineer of the actual quantity delivered at the site

B. Cutting, Bending and Placing

Measurement for payment of reinforcing steel bars will be made on the weight of reinforcing steel bars actually placed with the concrete structure and drilled holes for anchorage in accordance with the Drawings and Bar Schedule approved by NIA or as directed by the Engineer and weights will be computed based on the published manufacturer's weights or in the absence thereof, on the weights specified in the table presented in Paragraph 2302. Steel bars in laps or splices indicated in the approved reinforcement Drawings, as required by NIA will be measured for payment. Additional steel bars in laps which are authorized for the convenience of the Contractor and such items as wires, clips, chairs, or other devices for securing the steel bars in place will not be measured for payment. Where weld splices are specified on the Drawings, weld splices will not be measured for payment but the weight for its equivalent lap splices will be measured for payment instead. Where contractor chooses to weld reinforcement bars for

his convenience and welding is not specified, no separate payment will be made for such welds. Where Contractor substitute welded splices for lapped splices, separate payment will not be made for such welds, but instead the weight for the lapped splices shown on the Drawings will be measured for payment.

2307 BASIS OF PAYMENT

Payment for reinforcing steel bars measured as provided above, will be paid for at the contract unit price per kilogram which price and payment shall constitute full compensation for furnishing all labor, tools, equipment and all incidentals and subsidiary works necessary for the successful completion of the work described under this Section.

As indicated in the Bill of Quantities, payment per kilogram of reinforcing steel bars (same measurement as provided above) shall be made separately and in accordance with the following schedule:

- a) Ninety percent (90%) of furnishing and delivery cost which shall include all labor, tools, equipment and supplies involved in the manufacture, and delivery to the project site which includes loading, hauling, unloading and stockpiling at the delivery site;
- b) Ten percent (10%) of furnishing and delivery cost shall be paid upon successful completion of the works under this Section.
- b) installation cost which shall include all labor, tools and equipment involved in cutting, bending and placing into permanent structures and all incidentals necessary for the successful completion of the work under this Section.

SECTION XXIV

REINFORCED CONCRETE PIPES

2401 SCOPE

The work under this Section shall include furnishing or the fabrication or manufacture of reinforced concrete pipes, laying or installation including jointing and construction of collars of the reinforced concrete pipes for culverts, drainage crossings and other structures as shown on the Drawings and at such other places designated by the Engineer all in accordance with the Drawings and these Specifications. All reinforcing bars to be used in the fabrication or manufacture of reinforced concrete pipes shall be furnished by the Contractor.

2402 TYPES OF R.C. PIPES

The type of reinforced concrete pipes as shown on the Drawings shall be as follows:

1. Type A-1 Pipes subjected to 10-ton truck loading with minimum of 60 cm overfill
2. Type A-2 Pipes subjected to 20-ton truck loading with minimum of 60 cm overfill

2403 MATERIALS

The quality of materials shall conform to the applicable provisions of Section XV, Concrete and Section XXIII, Reinforcing Steel Bars.

Concrete for pipes shall be Class "Y" which shall have a cement factor of 392.12 kilograms per cubic meter of concrete and a minimum compressive strength of 3,000 pounds per square inch in 28 days. The maximum size of aggregates shall be one half inch. Reinforcing bars shall be as indicated in the Drawings. Lapping of ends of the ring bars shall not be less than 48 bar diameter.

2404 MANUFACTURE OF R.C. PIPES

Under these specifications, the Contractor could purchase finished products of R.C. pipes or fabricate them in accordance with these specifications.

The pipes shall meet the requirements of the standard specifications for Reinforced Concrete Culvert Pipes ASTM: C361-571 or latest revision. The pipes manufactured according to these specifications shall further meet the requirements as specified on the Drawings.

For pipes with one line of circumferential reinforcement, the nominal protective covering of concrete over the ring bars shall be 25% to 50% of the shell thickness reckoned from the inner surface of the pipe. For pipes with two lines of circumferential reinforcement, the following shall be adhered to:

1. Each line of circumferential reinforcement shall be assembled into a cage which shall contain sufficient member of longitudinal tie bars.
2. The distance between the two layers shall not be less than the diameter of the longitudinal tie bars plus 1/4 inch.
3. The two line layers shall be provided with spaces and tied together to form a single rigid cage.

For 20 centimeters R.C. Pipes (and smaller diameter) the thickness shall be 0.5 centimeters and reinforced with 3-strand barbed wire consisting of 10 centimeters pitch spiral and six longitudinal ties.

2405 INSPECTION, SAMPLING AND TESTING

R.C. Pipes to be fabricated or manufactured by the Contractor shall be subject to periodic inspection by NIA during the process of fabrication or manufacture. Sampling for testing shall be done during said inspection.

R.C. Pipes purchased by Contractor shall be sampled for testing after delivery to Contractor's stockyard.

Sampling for test, not more than three pieces, shall be taken at random among the pipes in a lot. A lot shall consist of 50 pieces of the same size and type delivered at a time to Contractor's stockyard.

The lot represented by the samples tested which failed to meet the specified requirements shall be rejected and Contractor shall immediately remove from the stockyard the pipes comprising the lot.

The samples for testing shall be tested in accordance with ASTM: C-497, and shall meet the physical requirements of ASTM: C-76. Cost for sampling and testing shall be at the expense of Contractor. Pipes with injurious defects revealed subsequent to acceptance of pipes at Contractor's stockyard or fabrication site shall be rejected.

2406 REJECTION

R.C. pipes shall be subject to rejection on account of failure to meet any of the specification requirements. Individual sections of the pipe maybe rejected due to the following:

1. Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of joint.
2. Defects that indicate imperfect proportioning, making and molding.
3. Surface defects indicating honeycombed or open texture.
4. Damaged ends, where such damage would prevent making a satisfactory joint.

2407 MARKING

The following information shall be clearly marked on each section of R.C. Pipes delivered:

1. The type of pipes, A-1, A-2 or A-3 and so on, and the diameter for the proper identification of the pipe.
2. Date manufactured, and trade-mark of the manufacturer if purchased from other manufacturers.

2408 CURING

Reinforced Concrete Pipes shall be cured in accordance with the provisions prescribed in Section XV, "Concrete".

2409 TRANSPORTATION AND DELIVERY OF R. C. PIPES

Contractor shall load and transport the R.C. Pipes to the installation site in a manner as to avoid damage to pipes. The R.C. Pipes shall be handled carefully with belt slings or other approved devices. The width of belt or other approved handling devices shall be adequate to prevent any damage. The R.C. Pipes shall be at no time be dropped but shall be lowered carefully and slowly into position. Any R.C. Pipe damaged during loading from the Manufacturer's plant or Contractor's fabrication site, or when in transit to the delivery site, or during unloading, or during installation will be rejected.

2410 EXCAVATION

Excavation for R.C. Pipes shall be performed in accordance with Section VI, Structure Excavation. Notwithstanding the provisions of Section VI, where rock or other unyielding materials will be encountered, the rock or unyielding materials shall be similarly removed to a depth not less than 15 cm. below the established grade and shall be refilled with suitable materials thoroughly compacted throughout. Recesses shall be excavated for any collar involve.

2411 LAYING OR INSTALLATION OF R.C. PIPES

The R.C. Pipes shall be laid carefully, ends fully and closely jointed, and true to the lines and grades as shown on the Drawings. Belts or other approved devices shall be provided for lowering the pipes when they are placed in trench. Each pipe section shall be securely attached to the adjoining sections unless otherwise specified, shall be filled with stiff mortar composed of one part Portland cement and one-half parts of sand. Cement, sand and water shall conform to the requirements for these materials given for concrete. The mortar shall be placed so as to form a durable, water-tight joint. After each section of pipe is laid and before the succeeding section is laid, the lower portion of the hub shall be plastered thoroughly on the inside with mortar to such depth as to bring the inner surfaces of the abutting pipes flush and even. After the section is laid, the remainder of the joint shall then be wiped and finished smooth. After the initial set, the mortar on the outside shall be protected from the air and sun with a cover thoroughly wetted earth or burlap. After the setting of the mortar of the joint, the construction of the reinforced concrete collar shall be done in accordance with the drawings. Any pipe which is not in true alignment or which shows any undue settlement after being laid, or is damaged shall be removed and relaid or replaced without extra compensation.

2412 BACKFILLING

2413

After the pipes have been installed and the mortar joints and reinforced concrete sufficiently set, selected materials from excavation or borrow shall be placed alongside the pipes in layer not exceeding 15 centimeters, in thickness and compacted thoroughly. The backfilling of pipes shall be done simultaneously at both sides and shall conform with the provisions prescribed in Section XII, Structure Backfill. When the construction calls for placing high embankment over the pipes, special instruction regarding the method of backfilling shall be given by the Engineer.

2413 METHOD OF MEASUREMENT

Reinforced Concrete Pipes of the various sizes and types specified in the Bill of Quantities will be measured by the number of pieces or by the number of linear meter of pipe as specified in the Bill of Quantities furnished and acceptably installed, jointed and provided with collar.

2414 BASIS OF PAYMENT

The various sizes and types of pipes measured as provided above will be paid at the contract unit price per linear meter of the respective types and sizes of R.C. pipes.

As indicated in the Bill of Quantities, payment per piece shall be made separately for the:

- a) Furnishing and delivery cost which shall include all labor, tools, equipment, supplies and other incidentals involve in the manufacture and delivery to the site which includes loading, hauling, unloading and stockpiling at the delivery site.
- b) Installation cost which shall include all labor, tools, equipment involved and all incidentals necessary for the successful completion of the work under this Section.

The cost of collars in R.C. pipes are considered included in the contract unit price of installation per linear meter of R.C. pipes.

Excavation and backfilling works are not considered subsidiary works under this Section, hence payments shall be made under "Structure Excavation" and "Structure Backfill", respectively in the Bill of Quantities.

SECTION XXV

BOULDER RIPRAP

2501 SCOPE

The work under this Section shall include furnishing and placing the boulders and spalls of appropriate sizes of filler stones or precast concrete blocks for riprap on the prepared subgrade, all in accordance with the Drawings and these Specifications or as directed by the Engineer. Boulders and spalls shall be obtained from sources designated by the Engineer.

2502 MATERIALS

Rocks, boulders or stone materials for riprap shall be hard, dense, durable, and free of fissures or defects that would tend to foster deterioration from natural causes. Rock or boulder materials shall have specific gravity of not less than 2.6, saturated surface dry when tested as specified in the Department of Water Resources Manual of "Testing Procedures for Soils", Designation 508, Parts C and D.

The shape of the rock or boulders shall be such that the minimum dimension of a rock or boulders is not less than 50% of the maximum dimension.

The sizes of rocks or boulders or precast concrete blocks shall be as specified on the Drawings. If precast concrete blocks is specified in the Bill of Quantities, materials shall conform to the applicable provisions of Section XV, Concrete and Section XXIII, Reinforcing Steel Bars, and shall also be in accordance with the Drawings or as directed by the Engineer. All reinforcing bars to be used in the fabrication of precast concrete blocks shall be supplied by Contractor unless otherwise specified in the Bill of Quantities.

2503 METHOD OF CONSTRUCTION

Boulder riprap shall be placed immediately following completion of the embankment, channel or section of the structure involved, unless otherwise directed by the Engineer.

On the prepared gravel blanket or subgrade, the boulders shall be laid and arranged properly as shown on the Drawings to offer maximum resistance to displacement due to high water velocity. Spalls of appropriate size filler stones shall be placed to fill spaces between the boulders. The rocks or boulders for riprap and boulder rockfill bank protection, after placement in their final position, shall conform to the lines and grades as shown on the Drawings.

2504 METHOD OF MEASUREMENT

Boulder riprap or boulder rockfill specified on the Drawings will be measured by the number of cubic meter of materials acceptably placed and computed based on the neat lines as shown on the Drawings.

Precast concrete blocks if specified in the Bill of Quantities will be measured by the number of cubic meter of materials acceptably fabricated and placed in accordance with the Drawings.

2505 BASIS OF PAYMENT

The volumes measured as provided above shall be paid for at the respective contract unit price per cubic meter, which price and payment shall constitute full compensation for furnishing all materials (except reinforcing bars for precast concrete blocks (if supplied by NIA), supplies, labor, tools, equipment and other incidentals or subsidiary works necessary for the successful completion of the work under this Section. Any excavation involved under this Section, is not considered a subsidiary work, hence it will not be measured for payment under this Section. Rather, it will be measured and paid for under "Structure Excavation".

SECTION XXVIII

GRAVEL BLANKET

2801 SCOPE

The work under this Section shall include furnishing, placing on approved subgrade and compacting the graded sand and gravel to the thickness indicated on the Drawings or as established by the Engineer.

If required on the drawings, the furnishing and installation of filter fabric shall also be included in this Section.

2802 MATERIALS

Materials for the gravel blanket shall meet all the requirements for 50 mm coarse aggregate specified in paragraph 1507.

2803 PLACING

The material shall be dumped on the prepared subgrade and spread in layers having an uncompacted thickness of not more than 25 centimeters. Each layer shall be compacted to achieve a relative density of 70% as determined by USBR Test E-12 by four complete passes of a vibratory compactor. The Contractor has the option to adopt any method of compacting the layers of materials approved by the Engineer.

If filter fabric is required on the drawings, the Contractor shall install or lay said fabric on prepared subgrade prior to dumping of materials.

2804 METHOD OF MEASUREMENT

Gravel Blanket will be measured by the cubic meter of materials acceptably placed and computed based on the neat lines and dimensions shown on the Drawings.

If materials placed by the contractor are more than what is required, the excess materials will not be measured for payment.

Filter fabric shall be measured separately and shall be paid in accordance with the provisions of Section XXIX, Filter Drain.

2805 BASIS OF PAYMENT

The volume measured as provided above shall be paid at the unit contract price per cubic meter, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, tools, equipment and all incidentals or subsidiary

works necessary for the successful completion of the work described under this Section. Excavation involved under this Section is not considered a subsidiary work, hence it will not be measured for payment under this Section. Rather, it will be measured and paid for under Structure Excavation.

SECTION XXIX

FILTER DRAIN

2901 SCOPE

The work under this Section shall include furnishing, placing on approved subgrade and compacting graded sand and gravel in layers and to the thickness and dimensions indicated on the Drawings, including furnishing and construction of weep holes to provide outlet for filter and flap valve, if any, all in accordance with these Specifications or as directed by the Engineer.

2902 MATERIALS

Filter materials shall consist of unweathered sand and gravel obtained from river bed deposits or from designated quarries. To meet the gradation requirements, crushing, screening and washing may be required. The materials shall be composed of tough, durable particles, reasonably free from thin, flat and elongated pieces and shall be well graded between the following limits:

U. S. Standard Seive Size	Percent Passing by Weight			
	1st Stage	2nd Stage	3rd Stage	Bedding
2 inches			100	100
1 inch		100	5-35	70-90
1/2 inch	100	90-100	0-5	45-75
No. 4	85-100	70-90		25-60
No. 8	70-95	40-75		15-45
No. 16	50-85	10-40		0-20
No. 30	25-70	0-20		
No. 50	5-50			
No. 100	0-30			
No. 200	0-10			

2903 METHOD OF CONSTRUCTION

The bed for the filter drain shall be excavated to the required elevation and dimension shown on the Drawings and then properly compacted as directed by the Engineer. The materials shall be damped and spread on the prepared bed and each layer shall be compacted by a suitable compactor to a degree approved by the Engineer. Placement of succeeding layers will be allowed only after the Engineer has approved the placement and compaction of the preceding layer. When concrete is to be placed directly

on the filter, the entire surface upon which concrete is to be placed shall be covered with a layer of reinforced building paper before concrete is placed.

2904 METHOD OF MEASUREMENT

Filter drain will be measured by the number of cubic meter of materials acceptably laid, compacted and provided with weepholes for outlets and flap valves, if any.

2905 BASIS OF PAYMENT

The volume measured as provided above shall be paid at the contract unit price, which price and payment shall constitute full compensation for furnishing all materials, supplies, labor, equipment, tools and all incidentals or subsidiary works necessary for the successful completion of the work described under this Section. Reinforced building paper required to cover the filter shall be included in the unit bid price for applicable concreting works.