

TECHNICAL SPECIFICATION

METRO VIGAN WATER DISTRICT OFFICE BUILDING EXTENSION

P. BURGOS ST. SOLIDWEST, VIGAN CITY, ILOCOS SUR



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Submitted by:



METRO VIGAN WATER DISTRICT

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Vigan City, Ilocos Sur

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TECHNICAL SPECIFICATION

SECTION 1.0 - CONCRETE

1.1 General

1.1.1 Scope

The work includes concrete construction complete in accordance with the plans and standard specifications for concrete and reinforced concrete works.

1.1.2 Reference Standards

The latest edition of following standards shall form part of this specification:

ACI	American Concrete Institute
211.01-85	Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete
301-84(R88)	Concrete, Structural for Building
309R-87	Standard Practice for Consolidation of Concrete
318-99	Building Code Requirements for Reinforced Concrete
AASHTO	American Association of State Highway and Transport Officials
M173-84	Concrete Joint Sealer, Hot-Poured Elastic Type Performed Expansion Joint Filler for Concrete
ASTM	American Society for Testing and Materials
C33-86	Concrete Aggregates
C31-88	Standard Practice for Making, Curing Concrete Test Specimen in the Field
C39-86	Compressive Strength of Cylindrical Concrete Specimen
C42-87	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C94-86	Standard Specification for Ready-Mixed Concrete
C143-78	Standard Test Method for Slump of Portland Cement Concrete
C150-86	Portland Cement, Specification for
C309-81	Liquid-Membrane Forming Compounds for Curing Concrete
C494-86	Chemical Admixtures

1.1.3 Requirements

Full coordination shall be given other trades to install embedded items. Provisions shall be made for setting items not placed in the forms. Before concrete is placed embedded items shall have been inspected, and test for concrete aggregates and other materials shall have been done.

1.2 Materials

1.2.1 General

Concrete shall be composed of Portland cement, fine and coarse aggregates, water and admixture as specified, all thoroughly mixed and brought to the proper consistency, uniformity and temperature for final placement.

1.2.2 Cement

Cement shall be Portland cement conforming to the ASTM Specification C150, Type I.

1.2.3 Water

Water shall be clean and free from injurious amounts of oils, acids, alkalies, salts and organic materials, or other substances that may be deleterious to concrete or steel.

1.2.4 Admixtures

Admixtures shall be subject to prior approval by the Engineer. The admixtures shall be capable of maintaining essentially the same composition and performance throughout the work.

- a). Plasticizing admixtures shall be free from chlorides and shall conform to ASTM C494. The admixtures shall be used in concrete mixtures in accordance with the manufacturer's instructions.
- b). Calcium Chloride shall not be used under any circumstances.

1.2.5 Fine Aggregates

Fine aggregates shall consist of natural sand, manufactured sand, or a combination thereof. If the fine aggregate shall be a combination of separately processed sizes, or if hatching shall result in a combination of natural and manufactured sand, the different components shall be batched separately. Fine aggregates shall consist of hard, tough, durable, uncoated particles. The specified percentages of fines in the sand may be obtained either by the processing of natural sand or by the production of a suitably graded manufactured sand. The shape of the particles shall be generally rounded or cubical and reasonably free from flat or elongated pieces. The use of beach sand shall be prohibited. The fine aggregate shall conform to the following specific requirements:

Sieve Designation		Cumulated Percentage by Weight Passing
Standard (MM)	U.S. Standard, Square Mesh	
9.5	3/8	100
4.75	No. 4	95-100
2.36	No. 8	-
1.18	No. 16	45-80
0.60	No. 30	-
0.30	No. 50	10-30
-	No. 100	2-10

In addition to the grading limits shown above, the fine aggregates, as delivered to the mixer shall have a fineness modulus of not less than 2.3 nor more than 3.0 and during normal operations, the grading of the fine aggregate shall be controlled so that the fineness modulus of at least nine (9) of ten (10) test samples of the fine aggregate as delivered to the mixer shall not vary more than 0.20 from the average fineness modulus of all samples tested during the preceding 30-day period. The fineness modulus can be determined by dividing by 100 the sum of the cumulated percentages retained on U.S. Standard Sieves Nos. 4, 8, 16, 30, 50 and 100. At the option of the contractor, fine aggregates may be separated into two or more sizes or classification, but the resulting combined sand shall be of uniformed grading within the limits specified above. It can be generally assumed that a fine blending sand maybe required to meet the above grading.

1.2.6 Coarse Aggregates

Coarse aggregates shall consist of gravel, crushed gravel or rock, or a combination thereof. The coarse aggregate as delivered to the batching plant shall have uniform and stable moisture content. The approval of deposits shall not be construed as constituting the approval of all the materials taken from the deposits and the Contractor shall be held responsible for the specified quality of all such materials used in the work. Coarse aggregate shall consist of hard,

tough, durable, clean and uncoated particles. All foreign materials and dust shall be removed by adequate processing. The particle shape of one of the smallest size of crushed coarse aggregate shall be generally rounded or cubical, and the coarse aggregate shall be reasonably free from flat and elongated particles. A thin, flat and elongated particle can be defined as a particle having a maximum dimension greater than five times the minimum dimension. The coarse aggregate shall be well graded from fine to coarse. It shall be separated into size groups.

The grading of the aggregate within the separated size groups as delivered to the mixer shall be as follows:

Sieve Sizes			
Standard (MM)	U.S. Std. Sq. Mesh	Percent by Weight Sizes 1- 1/2"	Passing Individual 3/4" size
50.00	2"	-	100
37.50	1-1/2"	-	90-100
25.00	1"	100	20-55
19.00	3/4"	90-100	0-15
9.50	3/8"	20-55	0-5
4.75	No.4	0-10	-

- Use 19mm (3/4) coarse aggregate for slab on grade, columns, beams, suspended slabs, the beams

- Use 38mm (1 1/2") coarse aggregate for footings

3.2.8 Hot Poured Joint Sealer

Hot poured joint sealer shall conform to AASHTO specification M173-80.

1.3 Storage of Materials

1.3.1 Cement

Cement in bags shall be stored in a suitable weatherproof structure which shall be as air tight as practicable; floors shall be elevated above the ground which shall be sufficient to prevent the absorption of moisture. Bags shall be stocked close together to reduce circulation of air but shall not be stocked against outside walls. The manner of storage shall permit easy access for inspection and identification of each shipment. Cement that has been in storage for so long that there may be doubt of each quality shall be tested by standard mortar test to determine its suitability for use, and shall not be used without approval of the Engineer.

1.3.2 Aggregates

Aggregates shall be stored in such a manner as to avoid the inclusion of foreign materials. Aggregates of different sizes shall be stored in separate piles. Stock piles of coarse aggregate shall be built in horizontal layers not exceeding 1200 mm in depth to avoid segregation. Should the coarse aggregate become segregated, it shall be remixed to conform to

the grading requirements given hereinbefore. Sufficient stockpiles shall be maintained at all times to prevent continuous placement of concrete at the rate specified.

1.4 Proportions, Mixing, Transport, Placing, Protection, and Curing and Repair to Concrete

1.4.1 Proportions

The proportions of all materials in concrete shall be subject to the approval of the Engineer. The Contractor shall employ on his own expense an approved testing laboratory which shall design the mixed proportions in accordance with ACI 211.01-85. **Strength requirements shall be 21.00 MPa (3000 psi) for slab, beams, and columns @ Foundation to 3th floor level including the foundation itself and 10.5 MPa (1500 psi) for lean concrete, or as required by the Engineer.** The adequacy of this mix shall be verified by a test on a minimum of 6 cylinders; 3 tested at 7 days, 3 at 28 days, in accordance with ASTM C39.

If, at any time during the construction, the concrete resulting from the approved mix design proves to be unsatisfactory for any reason such as too much water, lack of sufficient plasticity to prevent segregation, honeycomb, etc., or insufficient strength, the contractor shall notify the Testing Laboratory and the Engineer. The laboratory shall modify the design, subject to the approval of the Engineer until a satisfactory concrete is obtained.

1.4.2 Concrete Samples and Testing

The contractor shall be required to make test on concrete samples taken from actual pouring of concrete on site under the Supervision of the Engineer. Throughout the period the concrete is being poured into the forms and while spading operation are being done, sets of test samples in cylinder shall be taken from fresh concrete from the forms.

The Contractor shall employ, at his own expense, an approved testing laboratory which shall make the following test and immediately submit five copies of test reports to the Engineer. The following test shall be made each 10 cu.m. of concrete or fraction thereof, but not less than one (1) set of tests, shall be made from any one batch of concrete and all three (3) tests shall be made from the same batch.

a). **Compression Tests:**

The Contractor shall furnish six (6) standard 150 x 300 mm cylindrical mould and place on the fresh concrete inside the cylinder in three separate equal layers rod separately with 16mm diameter rod 25 strokes, with the tamping end rounded to a hemispherical tip of the same diameter. Level the surface with trowel and label the samples identifying the proportion of concrete, date taken and place taken. These samples are to be cured in the same manner as to the concrete in the construction cured.

Test one cylinder at the age of seven (7) days, and one cylinder at the age of twenty eight (28) days, in accordance with ASTM C31 and C39. Keep one

cylinder in reserve for a fifty six day test, if the twenty eight day test does not meet the requirements.

The Contractor shall make additional cylindrical sample as required or as directed by the Engineer, to check strength of concrete in the construction.

b). Slump Tests:

To determine the consistency of workable fluidity of freshly-mixed concrete in the field, the contractor shall keep all times a slump cone at the site. At least two slump tests shall be made and the sample of concrete from which test specimens are made shall be representative of the entire batch and shall conform to the procedures as specified in ASTM C143-78.

Place freshly-mixed concrete in the slump cone 100 x 200 mm x 300 mm in equal layers. Rod each layer with 25 strokes of the tamping rod 16 mm diameter with the tamping end rounded to a hemispherical tip of the same diameter. Level the mould and lift at once. Measure the slump action immediately by getting the difference in height between the height of the mould and the top of the slumped concrete.

The slump for vibrated concrete shall be 50 mm minimum and 100 mm maximum provided that the required strength of concrete is obtained.

c). Test Reports:

The testing laboratory shall submit four copies of its test cylinder reports which are to include as far as applicable, the following items: Location of pour in the structure, concrete design, mix number, concrete design strength, type and manufacturer of cement, amount of any admixture used, slump tests, date of sampling, cylinder application number, days cured in the field, days cured in the laboratory, age at time of testing, crushing stress, type of failure, who made the samples, who shipped the samples to the laboratory and whether concrete strength meets the specifications.

d). Additional Test

If, in the opinion of the Engineer, based on cylinder strengths below specifications requirements or visual defects, concrete of poor quality has been placed, additional test shall be made as directed by the Engineer and at the expense of the Contractor. Test may be compression test on cored cylinder, ASTM C42, and /or load tests as outlined in ACI 318, Sec. 202, or as directed.

1.4.3 Mixing Concrete

Concrete shall be thoroughly mixed in a mixer of an approved size and type that will ensure a uniform distribution of the materials throughout the mass:

a). Site Mixed Concrete.

All concrete shall be machine mixed for at least 1 1/2 minutes after all materials including water are in the mixing drum. The time elapse between the introduction of the mixing water to the cement and aggregates and placing of the concrete in final position shall not exceed 45 minutes. Placing of material in mixer shall be done in such a way that the first batch of concrete materials in the mixer shall contain sufficient excess of cement, sand and water to coat the inside of the drum without reducing the cement content of the mixed to discharged. The tampering of concrete, that is, placing additional cement, aggregate or water during mixing period shall not be permitted.

No hand mixing shall be allowed, except in case of emergency such as breakdown during pouring operations subject to the approval of the Engineer, and shall stop at the first allowed construction joints.

b). Ready-Mixed Concrete.

Ready-mixed concrete, when used shall be batched, mixed, and delivered from a plant approved by the Engineer and shall be in strict accordance with the requirements set forth in ASTM C-94.

The rate of delivery of the mixed concrete shall be such that the interval between placing of successive batches shall not exceed thirty (30) minutes. The elapsed time between the introduction of water to the cement and aggregate and completion of discharge shall not exceed one (1) hour or not more than 1 1/2 hours if a retarder is used. It should be kept constantly agitated during the transit period. Delivery tickets shall not exceed one (1) hour and contains the weight of sand, gravel and amount of cement and water added. The Contractor shall keep legible copies available for examination of the Engineer.

Re-tempering of concrete shall not be permitted. The Contractor shall mix only such quantities that are required for immediate use and mixture which has developed setting shall not be used. Concrete which has been partially hardened shall not be re-tempered.

1.4.4 Concrete Placing

Concrete shall be placed only after all formworks, installations of materials to be embedded and preparation of surface involved in the placing have been inspected and approved by the Engineer. The Contractor shall provide equipment and shall employ methods which will minimize separation of aggregates from concrete mix.

Water shall be removed from excavation before concrete is deposited. Any flow of water shall be diverted through proper side drains to a pump or be removed by other approved methods to avoid washing over freshly deposited concrete. Hardened concrete, debris and foreign materials shall be removed from interior of forms and from inner surfaces of mixing and conveying equipment. Reinforcements shall be secured in position, inspected and approved before pouring concrete. Run ways shall be provided for wheeled concrete handling equipments, such equipment shall not be wheeled over reinforcements nor shall runways be supported on reinforcements.

Concrete shall be handled from the place of final deposit as rapidly as practicable by methods which shall prevent the segregation or loss of the ingredients. It shall be deposited in the forms in approximately uniform horizontal layers and as nearly as practicable in its final position to avoid re-handling.

Conveying or handling of concrete by the use of long; inclined chutes or pipes or more than three (3) meters shall not be permitted. Dumping of concrete into buggies buckets or wheelbarrows with a free fall or more than one (1) meter shall not be permitted. When placing operations would involve dropping the concrete more than 1 1/2 meters, it shall be deposited through sheet metal or other approved conveyor. As for practicability, the conveyor shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly-placed concrete. After the initial set of concrete, the forms shall not be jarred and no strain shall be placed on the ends of the reinforcing bar which are being projected.

Concrete in columns shall be placed in one continuous operation. Concrete in girders, beam and slabs in superstructures shall be poured in a monolithic and continues manner. No construction joint shall be allowed on any part of the structure without the approval of the Engineer.

Consolidation: Consolidate all concrete in accordance with provisions of ACI 309R-87. Consolidate all layers of concrete greater than four inches in depth with high frequency, internal, mechanical vibrating equipment, supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading and settling with a heavy leveling straight edge.

Operator vibrators with vibratory element submerged in the concrete with a minimum frequency of not less than 6000 impulses per minute when submerged. Insert and withdraw vibrators approximately 18 inches apart. Penetrate the previously lift with the vibrator when more than one lift is required. Place concrete in 18-inch maximum vertical lifts. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation of aggregates. Provide adequate number of units and power source at all times. Maintain spare units to ensure

adequacy. If in the opinion of the Engineer, the equipment being used is not adequate to accomplish proper consolidation, the Engineer may order delay in proper placement of concrete until such equipment is available for use at the location of placement of concrete.

1.4.5 Protection and Curing

1.4.5.1 General.

Concrete surfaces exposed to conditions causing premature drying shall be protected as soon as possible with canvas, straw, burlap, sand or other satisfactory materials and kept moist; or if the surfaces are not covered they shall be kept moist by flushing or sprinkling, as directed by the Engineer. All concrete shall be moist cured for a period of not less than seven consecutive days after placing by an approved method or combination of methods applicable to local conditions.

1.4.5.2 Moist Curing.

The surface of the concrete shall be kept continuously wet with water for a period of seven (7) days, by spraying or covering with burlap or other approved material thoroughly saturated with water or keeping the covering wet by spraying or intermittent hosing. Water for curing shall be generally clean and free from any element which might cause objectionable staining or discoloration of the concrete.

1.4.6 Repairs to Concrete

All imperfections on concrete surfaces shall be corrected to produce concrete and concrete surfaces that conform to the requirements of this Section. Unless otherwise approved by the Engineer, repair of imperfections in formed concrete shall be completed after 24 hours of removal of forms. All imperfections on formed surfaces shall be repaired by patching with cement mortar. Cement used in the concrete, except that for exposed surfaces part of the cement shall be white cement to provide a finish color matching the surrounding concrete. Honeycombed or otherwise defective area shall be cut out to solid concrete but to depth of not less than 25 mm. The edges of the cut shall be perpendicular to the surface of the concrete. The area to be patched and at least 150 mm adjacent thereto shall be saturated with water before placing the mortar. The mortar shall be mixed approximately one hour before placing and shall be mixed approximately one (1) hour before placing and shall be remixed occasionally during this period with a trowel without adding water. A grout of cement and water, mixed to the consistency of paint, shall then be brushed onto the surface to which the mortar is to be bonded.

The mortar shall be compacted into place and screened slightly higher than the surface. Patches on exposed surfaces shall be finished to match the adjoining surfaces, after they have set for an hour or more. Patches shall be cured as specified for the concrete. Exposed surfaces shall utilize plywood forms, and after the removal of forms, shall not be plastered, unless otherwise directed by the Engineer. All joint marks of the formwork shall be reworked to a smooth surface to match adjacent areas and to present a neat appearance.

1.5 Forms

1.5.1 General

Forms shall be used wherever necessary to confine the concrete and shape it to the required lines and dimensions, or to protect the concrete from contamination. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in correct position. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Forms for exposed surfaces shall be lined with form grade plywood. Bolts and rods used for internal ties shall be arranged that when the forms are removed, they shall not be less than two (2) centimeters from the formed surface.

1.5.2 Cleaning and Oiling of Forms

Before placing the concrete, the contact surfaces of the forms shall be cleaned of encrustation of mortar, grout, or other foreign material, and shall be coated with standard form oil that can effectively prevent sticking and will not stain the concrete surfaces.

1.5.3 Removal of Forms

Forms shall be removed in a manner which shall prevent damage to the concrete. Forms shall not be removed without prior approval of the Engineer. Any repairs of surface imperfections shall be formed at once and curing shall be started as soon as the surface is sufficiently hard to permit it without further damage. The minimum time period for removal of forms shall govern where it exceeds the minimum specified curing period. Where the formwork for one element supports the framework for another element, the greater time period shall apply to both elements. Forms shall not be removed before the expiration of the minimum time specified below:

<u>Element</u>	<u>Time Period</u> <u>(Days Minimum)</u>	
Walls, columns, sides of beams and girders, and slabs on grade	1	
Pan joist forms (side only):		
30 inches wide more or less	3	
Over 30 inches wide	4	
Where design live load is:	less than	greater than
	dead load	dead load
Arch Center	14	7
Joist, beam, or girder soffits:		
Clear span between the structural supports		

Under 10 feet	7	4
10 feet to 20 feet	14	7
Over 20 feet	21	14

One way floor slabs: Clear span
between structural supports

Under 10 feet	4	3
10 to 20 feet	7	4
Over 20 feet	10	7

1.5.4 Support

Sufficient shoring members to support dead loads plus construction loads on beams and slabs shall be provided for a period of eight (8) days in addition to the seven (7) days specified thereto. The time for removal of forms for structures not included thereto shall be as directed by the Engineer. Concrete work shall be protected from damage during construction.

1.6 Reinforcing Steel

1.6.1 General

Steel reinforcement shall be provided together with all necessary wire ties, chairs, spacers, supports, and other necessary devices.

1.6.2 Material

Reinforcing steel shall be locally manufactured deformed billet-steel bars conforming to Philippine standard, **Grade 275, Intermediate Grade (40,000 psi) for bars with diameter of 12 mm and less , and Grade 414, High Strength (60,000 psi) for bars 16mm diameter and larger.**

1.6.3 Reinforcing Steel Samples and Testing

Reinforcing steel samples shall be 3 sets for every 30 tons of steel size requirements (bar diameter). Every set shall be compose of 1 tensile test and 1 bending test, thus, a meter sample shall be cut into 60cm and 40cm for the said tests respectively. Length of samples may be subjected to change depending on the requirement of the testing machine. Manufacturers shall issue mill certificates of the said steel bars to the contractor to be noted or approved by the structural engineer or the governing body.

1.6.4 Storage

Reinforcing steel shall be stored in a manner that will prevent excessive rusting or coating with grease, oil, dirt, and other objectionable materials.

1.6.5 Cutting and Bending

Reinforcing steel shall be accurately cut and bent in accordance with the approved detailed reinforcement drawings. Reinforcing steel shall not be straightened or rebent in a manner that will injure the material. Bars with kinks or with bends not shown on the approved detailed reinforcement drawings or with cracks or splits on the bends shall not be used. All bars shall be bent cold. If Contractor elects to have reinforcing steel cut and bent off the Site, he shall provide, maintain and operate a small cutting and bending shop on the Site and maintain a representative stock of steel. This provision is to take care of minor revisions and additions in an expeditious manner.

1.6.6 Placing

Reinforcing steel shall be accurately placed in accordance with approved detailed reinforcement drawings and shall be adequately secured against displacement by using specified tie wires or approved clips at all intersections. After it has been installed, reinforcing steel shall be inspected by the Engineer for compliance with requirements as to size, shape, length, splicing, position and number. Reinforcing steel shall be supported by concrete or metal supports, spacers, or metal hangers, except at surfaces exposed to the ground or to the weather, where supports shall be concrete. Wooden support and wooden spreaders shall not be used. At surfaces where an attractive appearance is paramount, the support shall be of a type which shall not cause subsequent staining or marring of the exposed surface.

1.7 Joints in Concrete

1.7.1 Construction Joint

Construction joints shall be provided where indicated in the Drawings or as directed by the Engineer. Joints not indicated on drawings shall be so made and located as not to impair the strength of the structures. When a construction joint is to be made, the surface of the hardened concrete shall be thoroughly cleaned and all laitance removed. In addition, the joint shall be thoroughly wetted and sloshed with a coat of neat cement grout immediately prior to placing of new concrete.

1.7.2 Expansion and Contraction of Joints

Expansion and contraction joints shall be provided where indicated and shall be in accordance with details.

1.7.3 Preformed Strips

Preformed strips shall be placed before the adjoining concrete of a joint is poured. The joint sealer shall be applied after concrete on both sides of the joint have been poured and after the joint lines have been trued.

1.7.4 Waterstops

1.7.4.1 General.

Waterstops of the types specified shall be placed by the Contractor at the locations shown on the drawings or as directed by the Engineer. The Contractor shall take suitable precautions to support and protect the waterstops during the progress of the work and shall repair or replace any damaged waterstops to the satisfaction of the Engineer.

1.7.4.2 Installation.

Waterstops shall be installed in joints as shown on the drawings or as otherwise directed by the Engineer. The type of material, location, dimensions, and method of installation shall be as shown on the drawings. In order to eliminate faulty installations that may result in joint leakage, particular care shall be taken to correctly position the waterstops during installation. The bottom of each waterstops shall be sealed to other cut-off systems. All waterstops shall be installed so as to form a continuous watertight diaphragm in each joint.

The Contractor shall replace or repair any waterstop punctured or otherwise damaged before final acceptance of the work to the satisfaction of the Engineer. Maximum density and imperviousness of the concrete shall be insured by thorough working of the concrete to be used in the vicinity of all joints. Suitable coverings shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from mechanical damage when concrete placement has been discontinued.

1.7.4.3 Material.

Rubber shall be either natural, synthetic, reclaimed or a combination of these types, conforming to applicable portions of ASTM Specification D-735, as follows:

Tensile strength, minimum	3000 psi
Elongation at break, minimum	450 %
Shore durometer (type A)	60 to 70
Absorption of water, by weight	

percent maximum (2 days at 70 deg. C)	5
Compression Set (constant deflection percent of original deflection, max.)	30%
Tensile strength after oxygen bomb aging (48 hrs., 70 deg.C, 300 psi) per cent of tensile strength before aging, min.	80%
Elongation after oxygen pressure test (48 hours, 70 deg. C, 300 psi) per cent of elongation before aging, min.	80%

1.7.4.4 Splicing.

Both field and factory splicing shall be done in accordance with recommendation of the manufacturer of the waterstop subject to the approval of the Engineer. Rubber waterstops shall be spliced by a hot vulcanizing process and shall have a tensile strength of not less than 50 percent of the unspliced material.

SECTION 2.0 - METALS

2.1 Scope

The work includes, furnishing, fabrication, erection or installation, complete of all structural steel and miscellaneous metal work in accordance with this specification unless required otherwise in the drawings.

2.2 Applicable Documents

The following specifications and standards (latest edition) but referred to hereinafter by basic designation only shall form part of this specification:

ASTM	American Society for Testing and Materials
A36 A36M-88	Structural Steel Specification for
A307-87	Bolts and Studs 60,000 psi Tensile Strength
A325-88	Standard Specification, High Strength Bolts for Joints
A570-85	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
A611-85	Steel, Cold-Rolled Sheet, Carbon, Structural Quality
AWS	American Welding Society
D1. 1-85	Structural Welding Code, Steel
AISC	American Institute of Steel Construction Specification for the Design, Fabrication Erection of Structural Steel for Buildings
AISI	American Iron and Steel Institute Specification for the Design, Fabrication Erection of Structural Steel for Buildings

2.3 Requirements

2.3.1 General

The Contractor shall submit to the Engineer for approval shop drawings showing the proposed re-alignment, replacement, fabrication and installation of all metal work. No work shall be started until the shop drawings have been approved, and all works shall conform to the approved shop drawings.

2.3.2 Materials

- 1) Structural steel shapes, plates and bars, unless otherwise shown or specified on the drawings shall conform to ASTM specification A36/A36M.
- 2) Hot-formed steel sheet and strip, unless otherwise shown or specified on the drawings shall conform to ASTM A570.
- 3) Bolts, nuts and washers shall conform to specification ASTM A307, with a minimum yield point of 33,000 psi, unless otherwise shown or specified in the drawings. Heavy hexagonal bolts, hexagonal nuts and hardened washers, shall be quenched and tempered medium, carbon steel bolts, nuts and washers complying with ASTM A325
- 4) Screws and expansion bolts shall be of a standard commercial grade, as approved by the Engineer, and of the sizes and types indicated.
- 5) Electrodes for arc welding shall be E60 or E70. AWS D1.1.
- 6) Miscellaneous metal items including accessories, incidentals, fastenings and anchorages not mentioned herein, or in other sections but are required to complete work, and for which there are no detail drawings, shall be provided and installed in accordance with standard practice of the trades as approved by the Engineer.

2.3.3 Fabrication

The work shall be well formed to the shape and size shown and assembled as detailed. Structural members shall be fabricated and assembled to the greatest extent possible. Shearing and punching shall produce a clean, true lines and surfaces with burrs removed. Nuts shall be drawn up tight. Joints which are to be exposed to the weather shall be watertight. Holes shall be cut, drilled, or punched at right angles to the surface of the metal and shall not be made or enlarged by burning. Holes in base or bearing plates shall be drilled.

2.3.3.1 Welding of structural steel shall be in accordance with the standard code of Arc and Gas Welding in Building Construction of the American Welding Society. All welding works shall be performed by qualified welders only.

2.3.3.2 Shop painting. Unless otherwise specified or indicated in the drawings, all structural steel work (except galvanized surfaces and surfaces that will be painted with epoxy) shall be given a shop coat of red lead or zinc chromate primer.

2.3.4 Erection

The steel structure shall be erected true to line and grades. Bracings and supports shall be introduced whenever necessary to take care of all the loads to which the structure may be subjected. Such bracings shall be left in place as may be required for safety. As erection progresses, the work shall be bolted to take care of all the dead loads, wind and erection stresses. No reaming of undersize bolt holes will be permitted, and erection bolts shall not be used for lining up members.

2.3.4.1 Drift pins.

Drift pins may be used only to bring together several parts, they shall not be used in such manner as to distort or damage the metal.

2.3.4.2 Gas cutting.

The use of gas cutting torch in the field for correcting fabrication errors shall not be permitted on any major member in the structural framing. Its use may be permitted only when the member is not under stress, and subject to the approval of the Engineer.

2.3.4.3 Base plates and bearing plates.

Base plates and large bearing plates shall be supported on steel wedges or shims until the supported member have been plumbed, following which the entire bearing area shall be grouted with non-shrink cement grout.

2.3.4.4 Setting up.

Steel shall be erected plumb, level and properly guyed. In setting or erecting of structural steel, the individual piece shall be considered plumb or level where the error does not exceed 1 to 500.

SECTION 3.0 - MASONRY

3.1 General

3.1.1 Scope

The work includes furnishing labor, equipment and materials, and performing all operations required to complete concrete masonry work as shown and specified on the drawings and specifications.

3.1.2 Applicable Documents

The following specifications and standards shall form part of this specification to the extent required by the references thereto.

ASTM	American Society for Testing Materials
C144-87	Standard Specification for Aggregate for Masonry Mortar
PSA	Product Standards Agency Pub. (Phil)
PNS 16-84	Concrete Hollow Blocks, Specs for

3.1.3 Requirements

Concrete masonry work of the type indicated shall be provided and shall be properly coordinated with the work of other trades.

3.2 Materials

3.2.1 Concrete Hollow Blocks

Concrete hollow blocks shall be a standard product of a recognized manufacturer conforming to PNS 16, as indicated on the drawings.

Load bearing CHB shall have a minimum ultimate compressive strength at 28 days $f_m = 6.97 \text{ Mpa}$ (1000 psi).

3.2.2 Cement, Reinforcing Steel, and Water

Cement, reinforcing steel and water shall be as specified in Section 1.0, CONCRETE.

3.2.3 Delivery, Storage and Protection of Materials

Delivery storage and protection of materials shall be as specified in Section 3.0, CONCRETE and as specified herein.

3.2.3.1 Concrete masonry units shall immediately upon delivery to the job site be stacked under covered area or otherwise protected from exposure to the weather and contact with soil. Care shall be exercised in handling the blocks to avoid breakage.

3.3 Installation

3.3.1 Workmanship

Masonry walls shall be placed level and plumb all around. One section of the walls shall not be placed in advance of the others. Unless specifically approved. Unfinished work shall be stepped back for joining with new work; tooting shall not be permitted. Heights of masonry shall be checked with an instrument at sills and heads of window frames, louvered openings, anchors, pipes and conduits shall be installed in carefully and neatly as the masonry work progresses. Spaces around metal door frames shall be filled solidly with mortar. Drilling, cutting, fitting and patching, to accommodate the work of others, shall be performed by skilled workers. Bolts, anchors, inserts, plugs, ties and miscellaneous metal work specified elsewhere shall be placed in position as the work progresses. Chases of approved dimensions for pipes and other purposes shall be provided, where indicated or worked on, shall be covered with a waterproof membrane, well secured in place. Walls and partitions shall be structurally bonded or anchored to each other and to concrete walls, beams and columns.

3.3.2 Mortar Mixing

Mortar materials shall be measured in approved containers, which shall insure that the specified proportions of materials can be controlled and accurately maintained during the progress of the work. Unless specified otherwise, mortar shall be mixed in proportions by volume. The aggregates shall be introduced and mixed in such a manner that the materials will be distributed uniformly throughout the mass. A sufficient amount of water shall be added gradually and the mass further mixed, not less than 3 minutes, until a mortar of the plasticity necessary for the purpose intended shall be obtained. The water can be controlled accurately and uniformly. Mortar boxes, pans, or mixer drums shall be kept clean and free of debris or dried mortar. The mortar shall be used before the initial setting of the cement has taken place; re-tempering of mortar in which cement has started to set shall not be permitted.

3.3.3 Proportion

Mortar shall be mixed in the volumetric proportions of one part portland cement and 3 parts sand.

3.3.4 Mortar Joints

Mortar joint shall be uniform in thickness, and the average thickness of any three consecutive joints shall be 9.50 mm. "Gage rods" shall be made and approved prior to starting the

work and shall be used throughout the work. Changes in coursing or bonding after the work has started shall not be permitted. Joints in masonry which will not be exposed shall be struck flush. Joints shall be brushed to remove all loose and excess mortar.

3.3.5 Concrete Masonry Unit Work

The first course of concrete masonry unit, shall be laid in full bed of mortar, for the full width of the unit; the succeeding courses shall be laid with broken joints. Concrete masonry units with the cells vertical shall have bed-joints formed by applying the mortar to the entire tops surfaces of the inner and outer face shells, and the head joints formed by applying the mortar for a width of about 25 mm to the ends of the adjoining units laid previously. The mortar for joints shall be smooth, not furrowed and shall be of such thickness that it will be forced out of joints as the units are being placed in position. Where anchors, bolts, ties and reinforcing bars occur within the cells of the units, such cells shall be solidly filled with mortar or grout as the work progresses. Horizontal tie reinforcement shall be provided where indicated. Reinforcement shall be continuous and provided in the longest available lengths. Reinforcement above and below openings shall extend and be embedded into the columns, unless otherwise shown on the drawings. Splices shall overlap not less than 150 mm. Reinforcement shall be embedded in the mortar joints in such manner that all parts shall be protected by mortar. The two top courses of filler block walls shall have their cores filled with grout when placed in position.

Unless otherwise shown on the drawings, the size and spacing of vertical bars shall be as follows:

For 150 mm (6") CHB	-	12 mm (1/2") dia. at 600 mm (24") on centers
For 100 mm (4") CHB	-	10 mm (3/8") dia. at 600 mm (24") on centers
For horizontal bars	-	12 mm (1/2") dia. at 600 mm (24") on centers (every third course) for 150 mm (6") and 100 mm (4") CHBs.

3.4 Quality Assurance Provisions

3.4.1 Samples of Materials

Samples of cement, sand, lime, reinforcing bars and concrete hollow blocks shall be submitted for inspection and approval before delivery of these materials to the site.

3.4.2 Tests and Test Reports

The testing requirements stated herein or incorporated in referenced contract documents may be waived provided certified copies of report of tests from approved laboratories performed on previously manufactured materials are submitted and approved. Test reports shall be accompanied by notarized copies from the manufacturer certifying that the previously tested materials is of the same type, quality, manufacture, and make as those proposed for this project.

SECTION 4.0 - CLEANING UP

After the building is finished, the Contractor shall make all areas within the building immaculately clean. All scaffoldings, cuttings, and other waste materials shall be removed at least one meter around the building and piled or dumped in one area in the rear or in the side yard.

The Contractor shall be responsible for the Final Inspection by the Building Permit Section of the City Engineering Office and shall be responsible for obtaining the Occupancy Permit for the Final Turnover of the building to the Owner.