

## SECTION 03200 CONCRETE REINFORCEMENT

### PART 1 – GENERAL

#### 1.1 SCOPE OF WORK

The WORK includes fabrication and installation of all steel bars and steel tie wire, clips, supports, chairs, and spacers required for the reinforcement of concrete as shown on the Drawings.

#### 1.2 RELATED SECTIONS

Not Used

#### 1.3 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following Standards apply to the WORK of this Section:

ASTM A82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A615/A615M ASTM A706/A706M	Deformed and Plain Billet – Steel Bars for Concrete Reinforcement
PNS 49	Philippine National Standard – Steel Bars for Concrete Reinforcement

#### 1.4 SUBMITTALS

- A. Detailed working drawings and bending schedules of all reinforcement.
- B. Samples and test certificates as required by the applicable Reference Standards.

#### 1.5 QUALITY ASSURANCE

The Contractor is responsible for the performance of all tests and inspection required by this Standard Specification. However, the owner reserves the right to perform any or all prescribed tests and inspection where such is deemed necessary to ensure that delivered materials conform to the specifications, and shall be paid for by the Contractor. The Contractor shall furnish the owner certified copies of records showing that each material has been pre-tested, and complied with all applicable requirements of this Standard. The Contractor shall, at his own expense, replace all rejected materials for failure to comply with this Specification.

### PART 2 – PRODUCTS

#### 2.1 MATERIALS

Reinforcement steel shall be deformed, new billet steel bars conforming to ASTM A615, Grade 60 and 40, substantially free from mill scale, rust dirt, grease or other foreign matter.

Chemical Composition: The percentages of carbon, manganese, phosphorus, sulfur and silicon on finished bars shall conform to the specified values in PNS 49 as shown in Table 2.

Rail-steel bars will not be permitted in the Work.

Table 2 – Chemical Requirements

Element	Chemical Composition, Per Cent Maximum	
	Hot-Rolled Non-Weldable Deformed Steel Bar	Hot-Rolled Weldable Deformed or Plain Steel Bar
Carbon	-	0.38
Manganese	-	1.26
Phosphorus	0.0625	0.058
Sulfur	0.0625	0.058
Silicon	-	-

Reinforcement steel shall bear a mill identification symbol, shall be tagged with the size and mark number so that different types may be identified, and shall be stored off the ground to protect the steel from moisture and dirt until placed in final position.

Steel wire for tying reinforcing bars and waterstops shall conform to ASTM A82.

The following reinforcing steel bar sizes shall be used for all reinforced concrete design under this Contract.

Bar Designation	Approximate Cross Sectional Area (mm <sup>2</sup> )	Approximate Unit Weight (kg/m)
#10	78	0.616
#12	113	0.888
#16	201	1.579
#20	314	2.466
#25	492	3.854
#28	615	4.833
#32	804	6.313
#36	1018	7.991

Should the Contractor wish to use reinforcing steel bars having areas different from those shown (with consequent different designations), the following requirements shall apply:

- If the proposed substitute bar has an area from 97% to 105% of the designated bar, a direct substitution may be made without changes to bar spacing.
- If the proposed substitute bar has an area less than 97% of the designated bar, substitution may be allowed provided bar spacing is reduced to not more than the minimum clear distance between bars.
- If the proposed substitute bar has an area more than 105% of the designated bar, changes in spacing is limited to a maximum spacing of 300mm. All proposed changes shall be submitted to the Engineer for approval.
- Changes shall be implemented upon approval by the Engineer of the reinforcing arrangement Drawings, required as shop drawings, which shall be finalized upon issuance by the Engineer of the guidelines on related criteria, as maximum and minimum spacing and bond strength.
- Approval by the Engineer of bar size substitutions does not relieve the Contractor of other specified requirements, including steel grade and bar deformations.

## PART 3 - EXECUTION

### 3.1 FABRICATION OF REINFORCEMENT

Reinforcement steel shall be accurately fabricated to the dimensions shown on the shop drawings and bar schedules.

All reinforcing bars shall be bent cold around a pin with a free revolving collar having a diameter of the bar of not less than the following:

- Four times for stirrups
- Six times for bars up to and including 25mm diameter
- Eight times for bars over 25mm diameter
- Ten times for bars 43mm and 57mm diameter

Reinforcement steel shall not be straightened nor rebent. Bars with kinks or bends not shown on the Drawings will not be accepted.

### 3.2 INSTALLATION OF REINFORCEMENT

All reinforcing bars shall be accurately placed as shown on the Drawings, and in accordance with the shop drawings and bar schedules. The reinforcing bars shall be secured against displacement with annealed iron wire ties of minimum GA#16 GI Wire (i.e. 1.39mm diameter) or suitable clips at the intersections.

Except as otherwise indicated on the Drawings reinforcement steel shall be installed with a clearance for concrete cover as follows:

- |                                     |       |
|-------------------------------------|-------|
| ▪ Concrete placed directly on earth | 75 mm |
|-------------------------------------|-------|

▪ Formed surfaces in contact with the soil, water or exposed to the weather	75 mm
▪ Concrete cover of main reinforcement steel for columns and beams	40 mm
▪ Walls not in contact with the soil, water or exposed to the weather	40 mm
▪ Top of slabs exposed to weather for Ø16 and smaller	
▪ Underside of slabs over water surface, but not in contact with the water	50 mm
▪ Top of slabs exposed to weather for Ø20mm and above	
▪ All other slab surfaces	20 mm

No reinforcing bars shall be welded.

All reinforcing bars in slabs shall be supported on concrete cubes or chairs of the correct height, containing soft steel wires embedded therein for fastening to the reinforcement steel. Such spacers or chairs shall have a minimum compressive strength of 24 MPa.

Reinforcing bars for vertical surfaces in beams, columns and walls shall be properly and firmly positioned from the forms by means of stainless steel (tipped) bolsters or other equal methods approved by the Engineer.

Reinforcement steel projecting from structures that are to be concreted or where concrete has already been poured shall not be bent out of its correct position.

**\*\* END OF SECTION \*\***

## SECTION 03300 CONCRETE

### PART 1 – GENERAL

#### 1.1 SCOPE OF WORK

The WORK includes furnishing all labor, materials, equipment and incidentals necessary for the construction of all concrete work.

#### 1.2 RELATED SECTIONS

Other Sections of the Specifications shall also apply to the extent required for proper performance of this Work.

Section 33009	Concrete Reinforcement
Section 33010	Concrete Finishes
Section 33011	Construction Joints

#### 1.3 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following Standards apply to the WORK of this Section:

ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams
ASTM C94	Ready-mixed Concrete
ASTM C143	Slump of Hydraulic-Cement Concrete
ASTM C150	Portland Cement
ASTM C347	Recommended Practice for Concrete Formwork, US Corps of Engineers CRD C-572
ASTM C494	Chemical Admixtures for Concrete
ASTM C805	Rebound Number of Hardened Concrete

## 1.4 SUBMITTALS

- A. Samples as required by the applicable Reference Standards and in accordance with Part 3 – EXECUTION of this Specification.

## 1.5 QUALITY ASSURANCE

The Contractor is responsible for the performance of all tests and inspection required by this Standard Specification. However, the owner reserves the right to perform any or all prescribed tests and inspection where such is deemed necessary to ensure that delivered materials conform to the specifications, and shall be paid for by the Contractor. The Contractor shall furnish the owner certified copies of records showing that each material has been pre-tested, and complied with all applicable requirements of this Standard. The Contractor shall, at his own expense, replace all rejected materials for failure to comply with this Specification.

## PART 2 – PRODUCTS

## 2.1 MATERIALS

- A. Cement: Cement shall be Portland Cement conforming to ASTM C150, Type II, as follows:

Table 1- Physical Requirements of Cement

Test	Requirement
Compressive Strength for ages indicated, min. 3 days 7 days	12.0 MPa 19.0 MPa
Time Setting by Vicat Method Initial Set, minimum Final Set, maximum	45 minutes 375 minutes
Fineness, by turbidimeter test, minimum	160 m <sup>2</sup> /kg

## B. Aggregates

1. Fine Aggregate: Fine aggregate shall be washed inert natural sand conforming to ASTM C33, and shall range in size from coarse to fine within the following limits of US Standard sieve sizes:

Table 2- Grading Requirements for Fine Aggregates

Sieve Designation	Per Cent (%) Passing
9.5 mm (3/8)	100
4.75 mm (No. 4)	95-100
2.36 mm (No. 8)	80-100
1.18 mm (No. 16)	50-85

0.60 mm (No. 30)	25-60
0.300 mm (No. 50)	5-30
0.150 mm (No. 100)	0-10
0.075 mm (No. 200)	0-3

2. Coarse Aggregate: Coarse aggregate shall be well graded crushed stone or washed gravel conforming to ASTM C33, size No. 67 as follows:

Table 3 – Grading Requirements for Coarse Aggregates

Sieve Designation	Weight Per Cent Passing
25 mm (1")	100
19.0 mm (3/4)	90-100
9.5 mm (3/8)	20-55
4.75 mm (No. 4)	0-10
2.36 mm (No. 8)	0-5
0.075 mm (No. 200)	0-1

3. Water: Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product.

4. Admixtures

- Admixtures conforming to ASTM C494 may be used upon approval of the Engineer in writing, to control the time setting, to effect water reduction and to increase workability. Proportioning and mixing shall be as recommended by the manufacturer.
- The admixture may be a hydroxylated carboxylic acid type or a hydroxylated polymer type, but shall contain no calcium chloride. The use of an admixture shall not change the required quantities of cement specified under Table 4 of this Section.
- The total air entrained measured at the discharge from the truck shall be 3.0 per cent maximum for finished slabs and 3.5 to 5.0 per cent for all other concrete.

## 2.2 QUALITY OF CONCRETE

- A. Before placing any concrete, the Contractor shall discuss with the Engineer the source of materials and concrete he proposes to use. Samples of aggregate and cement shall be furnished to the Engineer for testing.

- B. The Contractor shall submit to the Engineer, his proposed design mix for evaluation.
- C. Compressive strength, water-cement ratio and cement factor specified in Table 4 shall apply for regular and pumped concrete:

Table 4 – Concrete Quality Requirements

Test	Requirements	
	Concrete Fill	All Structural Concrete
Minimum Compressive Strength at 28 days (Mpa)	17.0	21.0 – 42.0
Maximum Net Water Content (liters/100kg cement)	62.0	53.0
Minimum Cement Content (kg/m <sup>3</sup> )	260	330
Total Air Content (%)	3.5 – 5.0	3.5 – 5.0
Concrete Temp., Max. (°C)	32	32

- D. Consistency of the concrete as measured in accordance with ASTM C143 shall be as shown in Table 5.

No excessively wet concrete will be permitted. Concrete delivered to the site having a slump more than that specified herein will be rejected.

Table 5 – Concrete Consistency

Type of Structure	Slump (mm)	
	Recommended	Range
Pavement and Slabs on Ground	50	25-75
Plain footings, gravity walls, slabs and beams	50-75	25-100
Heavy reinforced foundation walls and footings	75-100	50-125
Thin reinforced walls and columns	100	75-125

## 2.3 FORMS

- A. Forms shall be made of either steel or new lumber approved by the Engineer and shall be free from roughness and imperfections, substantially watertight, adequately braced and tied to prevent movement and displacement when concrete is placed and vibrated. No wooden spreaders will be allowed in the concrete. Forms shall be thoroughly cleaned before using and shall be treated with approved non-staining oil or other approved material and allowed to dry before placement of the reinforcing steel.
- B. Form ties in concrete exposed to view shall be the cone-washer type. Through bolts or common wire shall not be used for form ties.
- C. Molding or bevels shall be built into the forms to produce a 20-mm chamfer on all exposed projecting corners.
- D. Forms for walls shall have removable panels at the bottom for cleaning, inspection and scrubbing-in of bonding paste.

## PART 3 - EXECUTION

### 3.1 MIXING CONCRETE

- A. Ready-mixed or transit-mixed concrete shall conform to ASTM C94. The concrete supplier shall furnish to the Engineer for his approval, the dry proportions to be used, with evidence that these will produce concrete of the quality specified.
- B. Ready-mixed or transit-mixed concrete shall be transported to the site in watertight agitator or mixer trucks. Discharge at the site shall be within one (1) hour after the cement was first introduced into the mix. Retempering (i.e. mixing with or without additional cement, aggregate or water) of the concrete which has partially hardened, will not be permitted.

### 3.2 PLACING OF CONCRETE

- A. All debris, dirt and water shall be removed from the forms. Forms, reinforcement steel, pipes, conduits, sleeves, anchors and other embedded items shall be inspected and approved by the Engineer before placing any concrete. The Contractor shall advise the Engineer of his readiness to proceed at least 12 hours before each placement of concrete.
- B. The surfaces of previously placed concrete, such as vertical or horizontal construction joints, shall be roughened, cleaned of foreign matter and laitance, and saturated with water.

Immediately before the new concrete is placed, all hardened surfaces shall receive a thorough coating of neat cement grout at least 5 mm thick which shall be well scrubbed in by means of stiff bristle brushes. The new concrete then shall be placed before the grout sets up.

Concrete shall be uniformly placed during the process of depositing until the completion of the layer to maintain an approximately horizontal plastic surface. The rate of placing concrete in forms shall not exceed 0.60 meter of vertical rise

per hour. The spreading of mounds of concrete with vibrator or by shoveling will not be permitted.

- C. Concrete shall not be placed in water or stay submerged within 24 hours after placing, except for curing nor shall running water be permitted to flow over concrete surfaces within four days after the placing of concrete.
- D. Chutes for conveying concrete shall be of U-shaped metal and provided with a baffle plate at the end. Chutes shall be placed at an angle of not less than 25 degrees, nor more than 45 degrees from horizontal and shall be kept clean and free from hardened concrete. Maximum length of chute to be traveled by plastic concrete shall not be more than 1.50 meters.
- E. In thin walls or columns of considerable height, the concrete shall be placed in such a manner as to prevent segregation and accumulation of hardened concrete on the forms or the reinforcement steel located above the concrete mass. Free fall of concrete shall not be permitted to exceed 1.50 meters below the ends of hoppers, chutes, ducts, tremies, or "windows" in wall forms, without approval of the Engineer.
- F. Where waterstop type construction joints are provided, the concrete shall be properly worked by rodding and vibrating around the waterstops to produce watertight joints, before any concrete is poured on the upper surfaces, particularly in the case of horizontal waterstops in slabs.

Waterstops shall be accurately positioned and securely held in place, and shall be protected at all times to prevent damage or displacement. Any damage to, or displacement of waterstops shall be corrected by the Contractor to the satisfaction of the Engineer.

### 3.3 TAMPING AND VIBRATING

- A. During and immediately after placing the concrete, compaction shall be carried out by experienced operators using high-speed internal mechanical vibrators. Care shall be taken to ensure that vibration is continued long enough to produce optimum consolidation without segregation of the aggregates or migration of air.
- B. At least one vibrator shall be used for every eight cubic meters of concrete placed per hour. One spare vibrator in operating condition shall be available on the site.
- C. Vibrators shall be supplemented with proper wooden spade, puddling adjacent to forms and rodding around embedded fixtures, to remove trapped air bubbles and to prevent honeycombing.

### 3.4 CURING AND PROTECTION

- A. All concrete work shall be properly cured. Details of the Contractor's curing procedures and curing compounds intended to be used shall be subject to the approval of the Engineer.
- B. All exposed surfaces including finished surfaces shall be treated immediately after concrete has been poured, to provide continuous moist curing for at least 7 days. Walls and vertical surfaces may be covered with continuously saturated burlap or kept moist by other approved means. Horizontal surfaces, slabs, etc. shall be

ponded to a depth of 15mm or kept continuously wet by means of sprinklers or other approved methods.

- C. Formed surfaces shall be thoroughly soaked with water at least twice each day until the forms are removed. Curing shall continue as specified above.
- D. Where finishing of concrete surfaces is performed before the end of the curing period, the concrete shall not be permitted to dry out and shall be kept continuously damp by means of a fog of water from the time the concrete has been placed until the end of the curing period.
- E. The Contractor shall protect all concrete work against injury from the elements and defacements of any nature during construction operations.

### 3.5 REMOVAL OF FORMS

- A. The Contractor shall not remove any forms for at least 48 hours or until the concrete has attained a strength of at least 30 per cent of the ultimate 28-day strength. This is equivalent to approximately 50-day-degrees of moist curing. Day degree represents the total number of days times the average daily air temperature in °C at the surface of the concrete, e.g. 2 days at an average temperature of 25°C equals 50 day-degrees.
- B. Forms for beams and slabs shall not be stripped for at least 150-day degrees and supports shall not be removed until the concrete has attained at least 60% of the specified 28-day strength and is capable of safely supporting its own weight. Construction live loads shall not be placed upon it until the concrete has attained its specified 28-day strength.
- C. Removal of forms shall be in accordance with ACI - 347. Forms shall be stripped such that they will not damage the concrete. No forms shall be removed until the concrete has gained sufficient strength to support itself. The Contractor is responsible for the safety of all structures.

### 3.6 REPAIR OF DEFECTIVE CONCRETE

- A. Defective or honeycombed areas, as determined by the Engineer, shall be chipped down to at least 25mm deep into sound concrete by means of chisels or chipping hammers. If honeycombs exist around reinforcement steel a clear space, at least 10mm wide shall be chipped all around the steel.
- B. For areas less than 40mm deep, the patch may be made as in filling form-tie holes.
- C. Thicker repairs will require build-up in successive 40mm deep layers on successive days, and each layer shall be applied with neat cement pastes.
- D. For very deep patches, a non-shrink aggregate, with or without the addition of pea gravel, may be the used subject to the approval of the Engineer.
- E. The materials shall be mixed as recommended by the manufacturer of the non-shrink aggregate or as directed by the Engineer.

Where a metallic non-shrink aggregate is utilized, the final 15mm of the patch shall be composed of 1 to 1-1/2 cement / sand mortar without the non-shrink aggregate

to prevent rust staining of the surface. After hardening, the patch shall be rubbed as for filling form-tie voids, in accordance with Section 33010, Rubbed Finish.

- F. All exposed concrete surfaces and adjoining work stained by spilling or leakage of concrete shall be cleaned to the satisfaction of the Engineer.

### 3.7 INSPECTION

Installation of reinforcing steel, pipes, sleeves, anchors and other embedded items, batching, mixing, transportation, placing, curing and finishing of concrete shall at all times be subject to the inspection of the Engineer. No concrete shall be placed without the prior approval of the Engineer.

### 3.8 FIELD CONTROL

- A. Sets of six (6) cylinder specimens shall be taken at random by the Contractor in the presence of the Engineer in accordance with ASTM C31. One (1) set per 50 cubic meters of concrete, or fraction thereof, poured during the day shall be made for the compressive strength test. At least one set of samples for strength test shall be made for each class of concrete.
- B. Two (2) cylinders shall be tested after 7 days and two cylinders after 28 days. Should the average strength of the 28-day test specimens be less than the specified value, a verification test shall be conducted on the remaining two (2) cylinder samples, after 28 to 45 days. Compressive tests shall be in accordance with ASTM C39 and shall be performed by a laboratory engaged by the Owner. Testing fees shall be paid by the Contractor.
- C. The Contractor shall assist, cooperate and provide the concrete for the test cylinders and such auxiliary personnel and equipment needed to take the test specimens.
- D. Ready-mixed concrete shall be sampled and tested in accordance with the following methods.

Table 9 – Sampling and Test Methods for Ready-Mixed Concrete

Sampling/Test Method	Applicable ASTM Standard
Compressive Test Specimens	C31
Compression Tests	C39
Yield, Unit Weight	C138
Air Content	C138/C173/C231
Slump	C143
Sampling Fresh Concrete	C172
Temperature	C1064

## 3.9 FIELD TESTING

- A. Should the average strength of the verification test specimens be less than the specified value, the Engineer may take further core samples from the portion of the structure which was determined by the Engineer to represent the deficient 28-day/verification test specimens.
- B. If the strength of any core samples is less than the minimum requirements shown in Table 4, the Contractor shall strengthen or replace the portions of the structure concerned at no additional cost and to the satisfaction of the Engineer.
- C. The Contractor shall also deduct from payments otherwise due to him, the actual cost to the Owner for taking all core samples extracted from that portion of the Work.
- D. Slump tests, temperature and entrained air measurements shall be made when specimens for strength tests are taken and during placement of concrete, as often as necessary for control checks. If measured slump or air content falls outside the specified limits, a check test shall be made immediately on another portion of the same composite sample. In the event of a second failure, the concrete shall be considered to have failed the requirements of the specification and the whole batch shall be rejected.

## 3.10 BASIS OF ACCEPTANCE / REJECTION

Final acceptance of all concrete will be based on satisfactory results of compressive strength tests.

Strength tests representing each class of concrete must meet the following two requirements:

- The average of any three consecutive strength tests shall be equal to, or greater than the specified strength.
- No individual strength test shall be more than 15% below the specified strength.

Except as provided below, acceptance criteria will be as outlined in ASTM C94 and ACI 318. Concrete which achieves the required compressive strength will be accepted as satisfactory for payment provided placement, finish and tolerance meet the specified requirements.

Concrete with average strength deficient by not more than fifteen per cent (15%) of the required strength may be accepted, subject to cost reduction given in the following schedule:

Per Cent (%) Deficiency In Average Strength	Per Cent (%) of Unit Price Reduction
Less than 3	0
0 to less than 5	15
5 to less than 10	30
10 to 15	40

more than 15	100
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Concrete represented by test results wherein the average strength indicated a deficiency of not more than fifteen percent (15%) but with an individual test deficient by more than fifteen percent (15%) will not be eligible for payment but may be accepted or ordered replaced at the discretion of the Engineer.

Concrete represented by compressive strength tests that fail to achieve the required strength as specified, shall be liable to rejection and subsequent removal and replacement.

However, if any strength tests falls below the specified value by more than 15%, or an individual test is deficient by more than 15%, and load carrying capacity has been significantly reduced, tests of cores drilled from the area in question may be required in accordance with ASTM C42, wherein L/D ratio is not less than 1.25 prior to capping. In such cases, three (3) cores shall be taken for each strength test more than 15% below the required value.

If concrete in the structure will be dry under service conditions, cores shall be air dried for 7 days before test and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, cores shall be immersed in water for at least 40 hours and be tested wet.

Concrete in an area represented by core tests shall be considered structurally adequate if the average of three (3) cores is equal to at least 85% of the specified strength, and if no single core is less than 75% of the minimum requirement. Additional testing of cores extracted from locations represented by erratic core strength results shall be permitted.

Acceptance and subsequent payment of concrete in question shall be based on the results of such tests, provided the complete operation has been supervised by the Engineer.

Rebound hammer test (ASTM C805) may be carried out by the Contractor prior to drilling core samples from structure in question, but the results of such rebound tests shall not be used as basis for acceptance or rejection of the concrete.

**\*\* END OF SECTION \*\***

## SECTION 04200 MASONRY

### PART 1 – GENERAL

#### 1.1 SCOPE OF WORK

The Work includes furnishing all labor, materials, equipment and incidentals required to construct all concrete masonry unit walls including the following:

- Concrete hollow block walls.
- Masonry reinforcing bars for concrete blocks.
- Grouting.
- Connecting wall anchors, ties, bolts and related embedded items.
- Installation of frames for doors, windows, louvers, steel lintels, and recessed fixtures.

#### 1.2 RELATED SECTIONS

Other Sections of the Specifications shall also apply to the extent required for proper performance of this Work.

Section 33030	Cement Plastering
Section 33019	Caulking and Dampproofing
Sections 33020 to 33028	Doors, Windows and Glass

#### 1.3 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following Standards apply to the WORK of this Section:

ASTM C33	Concrete Aggregates
ASTM C90	Loadbearing Concrete Masonry Units
ASTM C144	Aggregate for Masonry Mortar
ASTM C150	Portland Cement

#### 1.4 SUBMITTALS

- A. Detailed working drawings.
- B. Samples as required by the applicable Reference Standards.

## 1.5 QUALITY ASSURANCE

The Contractor is responsible for the performance of all tests and inspection required by this Standard Specification. However, the owner reserves the right to perform any or all prescribed tests and inspection where such is deemed necessary to ensure that delivered materials conform to the specifications, and shall be paid for by the Contractor. The Contractor shall furnish the owner certified copies of records showing that each material has been pre-tested, and complied with all applicable requirements of this Standard. The Contractor shall, at his own expense, replace all rejected materials for failure to comply with this Specification.

## 1.6 PROTECTION OF MATERIALS

All perishable materials for the Work of this Section shall be delivered, stored and handled to preclude damage of any nature. Manufactured materials, such as cement, shall be delivered and stored in their original containers, plainly marked with identification of material and maker. Materials in broken containers, or in packages showing watermarks or other evidence of damage, shall not be used and shall be removed from the site.

## PART 2 – PRODUCTS

### 2.1 MATERIALS

#### A. Cement

Portland cement shall conform to ASTM C150, Type I. Masonry cements shall not be used. One color of cement shall be used throughout the Work.

Cement shall be used for the application intended and in accordance with the approved recommendation of the manufacturer.

#### B. Sand for Mortar

Sand shall be clean, durable particles, free from injurious amounts of organic matter and shall conform to the requirements of ASTM C144, Aggregate for Masonry Mortar.

Sand for grout shall conform to ASTM C144 or C33 as required.

#### C. Water

Water shall be free from injurious amounts of oils, acids, alkalis, organic matter, and shall be clean and fresh.

#### D. Concrete Hollow Blocks

##### 1. Classification

Concrete block shall conform to ASTM C90, Type I, Normal Weight.

##### 2. Manufacturing Requirements

Table 3 - Minimum Thickness of Face Shells and Webs

Nominal Width mm (in.)	Face Shell Thickness (Minimum, mm)	Web Thickness (Minimum, mm)
102 (4")	19	19
152 (6")	25	25
203 (8")	32	25

## 2.2 MORTAR MIXES

Masonry mortar for setting blocks shall be in the proportion of 1 part cement to 3 parts sand or as otherwise approved by the Engineer. Mortar shall be mixed with water in an amount compatible with workability. Ingredients shall be accurately measured by volume.

Mixing shall be done immediately before usage. The Contractor shall use the dry-mix method, wherein the materials for each batch shall be well turned together until the cementitious materials has been thoroughly distributed throughout the mass, after which the water shall be gradually added until a thoroughly mixed mortar of the required plasticity is obtained.

Mortar boxes shall be cleaned out at the end of each day's work and all tools shall be kept clean. Mortar that has begun to set shall not be used.

The mixing of mortar by hand will be permitted only when the quality of hand mixing is comparable to mechanical mixing. The Engineer reserves the right to reject hand mixing and require all mixing by mechanical means. Mortar shall not be retained for more than 1-1/2 hours and shall be constantly mixed until used.

Pointing mortar shall be prehydrated mortar mixed dry, and water added while mixing to obtain a damp, or workable mix. After one or two hours, sufficient water shall be added to bring it to proper consistency, which shall be somewhat drier than masonry mortar.

The color of mortars shall be uniform throughout for adjoining areas, and shall be satisfactory to the Engineer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. General

All masonry shall be laid plumb and true to lines. Masonry shall be carried up in a uniform manner. No portion shall be raised more than one meter above adjacent portions, except with the approval of the Engineer.

#### B. Concrete Hollow Block

- Concrete blocks shall be laid in running bond, unless otherwise indicated. Joints shall not exceed 10 mm, shall be uniform throughout, and finished slightly concave and smooth.

Pointing shall be performed with the proper tools to a dense and neat finish. Finger pointing will not be allowed.

All blocks shall be laid in a full bed of mortar applied to shells. Apply mortar to the vertical joint of blocks that have already set in the wall, and to all contact faces of the unit. Each unit shall be placed and shoved against the previously laid block to produce a well-compacted vertical mortar joint for the full shell thickness.

Intersecting bearing walls shall be tied together with metal ties at 0.80-meter vertical spacing. Bends of tie and reinforcing bars shall be embedded in cells filled with mortar.

Concrete blocks shall be reinforced with gage 10mm diameter at 0.60 meter on centers in vertical and horizontal direction.

- All necessary block cutting shall be neatly done by a masonry saw or cutting shall be done by hammering at any times with an approved hand tool.
- Unless otherwise shown on the Drawings, door, window and louver frames shall be installed using screws and expansion shields. All frames shall be set tightly against the masonry wall.
- Control joints shall be installed as detailed on the Drawings. The joints shall be raked out to a depth of 20 mm for the full height of the wall and caulked. The maximum length between joints shall be 10 meters, if not shown on the Drawings, or as directed by the Engineer.

Joints made at the intersection of block walls with structural concrete, and where indicated, shall be filled with mortar grout and pointed.

#### C. Concrete Hollow Block to be Plastered

Concrete block walls, which are to be plastered, shall be laid in running bond. Joints are to be left rough to assist in the bonding of plaster. Otherwise, concrete block masonry shall conform to paragraph B, Concrete Hollow Block. Control joints in plastered block walls shall be carried through the plaster, but the joints shall not be plastered.

### 3.2 LINTELS, TIES AND MISCELLANEOUS ITEMS

The Contractor shall build in all miscellaneous items specified in other sections to be set in masonry including frames, lintels, reinforcing steel, electrical boxes and fixtures, sleeves, grilles, anchors and other miscellaneous items. All anchorage, attachments, and bonding devices shall be set so as to prevent slippage and shall be completely covered with mortar.

### 3.3 GROUTING

Grout and cement mortar for setting railings, frames in walls and where otherwise required shall be done with mortar of 1 part cement to 1 part sand. Before placing grout, thoroughly clean all surfaces. Grout shall be tamped into place with a blunt tool to fill the entire void. In the event space does not permit tamping, the Contractor shall build the necessary forms and place the grout by pouring from one side only. When grout is placed by pouring, a head of grout shall be maintained in the form. Grout shall be kept wet for three days after the temporary supports or adjusting wedges are removed; the empty space shall be filled with grout and shall be pointed.

### 3.4 CLEANING

All exposed masonry work shall be thoroughly cleaned. Mortar smears and droppings on concrete block walls shall be dry before removal with a trowel. Masonry work may be cleaned using a mild muriatic acid solution.

**\*\* END OF SECTION \*\***

## SECTION 05100 STRUCTURAL STEEL

### PART 1 – GENERAL

#### 1.1 SCOPE OF WORK

The Work includes providing all labor, materials, equipment and incidentals necessary to furnish and install all structural steel items including bearing plates and miscellaneous shapes and plates required for proper erection of structural materials as shown on the Drawings.

#### 1.2 RELATED SECTIONS

Other sections of the Specifications shall also apply to the extent required for proper performance of this Work.

Section 33014                      Miscellaneous Metals

#### 1.3 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following Standards apply to the WORK of this Section:

ASTM A36	Carbon Structural Steel
ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105 Ksi Minimum Tensile Strength
ISO 261	ISO General Purpose Metric Screw Threads - General Plan
AWS A5.1	Mild Steel Covered Arc-Welding Electrodes
AWS D1.4	Structural Welding Code – Reinforcing Steel
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete

#### 1.4 SUBMITTALS

- A. Detailed shop drawings of all structural steel items.
- B. Samples as required by the applicable Reference Standards.

#### 1.5 QUALITY ASSURANCE

The Contractor is responsible for the performance of all tests and inspection required by this Standard Specification. However, the owner reserves the right to perform any or all prescribed tests and inspection where such is deemed necessary to ensure that

delivered materials conform to the specifications, and shall be paid for by the Contractor. The Contractor shall furnish the owner certified copies of records showing that each material has been pre-tested, and complied with all applicable requirements of this Standard. The Contractor shall, at his own expense, replace all rejected materials for failure to comply with this Specification.

## **PART 2 – PRODUCTS**

### **2.1 MATERIALS**

- A. Structural shapes, plates and bars unless otherwise noted shall conform to the requirements of ASTM A36.
- B. Welding rods shall conform to AWS A5.1. All welding rods shall be E70XX grade.
- C. High strength steel bolts shall conform to ASTM A325.
- D. Hexagonal Nuts
- E. Standard Washers

## **PART 3 - EXECUTION**

### **3.1 FABRICATION AND ERECTION**

- A. Details of concrete reinforcement steel for fabrication and erection shall conform to ACI 315, unless otherwise specified.

All members shall fit closely together and shall be straight and true; the finished work shall be free from burrs, bends, twists and open joints.

Materials for welding shall be the best available as recommended by the manufacturer of the materials to be welded, and in accordance with AWS Standards.

- B. All holes, angles, supports, and braces shall be provided as required. Any unmatched holes in shop assembly of field connections shall be reamed and the pieces match marked before disassembly.

Drift pins shall be used only for bringing members into position and not to enlarge or distort holes.

Any piece weakened by reaming to compensate for eccentricity to a point where the strength of the joint is impaired will be rejected and a new and satisfactory piece shall be provided by the Contractor at his own expense.

Slotted holes and washers shall be provided for truing-up steel requiring accurate alignment.

- C. Anchor bolts shall be accurately located on the base plates and welded in position.

### **3.2 FIELD CONNECTIONS**

Base plates where required shall be accurately placed in position.

Field connections shall be made by welding or high strength bolting.

### 3.3 WELDING

Welding of parts shall be in accordance with the Structural Welding Code D1.1 of the AWS and shall only be done by welders certified as to their ability to perform welding in accordance with the locally accepted requirements.

The Contractor may substitute field bolting where field welding is shown, provided bolting details have been approved by the Engineer.

### 3.4 BOLTING

High-strength bolts shall conform to ASTM A325.

Anchor bolts shall be of mild steel with hexagonal nuts. Threads shall be clean cut and conform to ISO 261. Anchor bolts shall be hot-dip galvanized and shall be accurately set before the concrete is poured unless specifically permitted otherwise by the Engineer. To facilitate the setting of anchor bolts, the Contractor shall use screed plates, or may substitute wooden templates instead of screed plates upon written approval of the Engineer.

Anchor bolts with pipe sleeves shall be in accordance with the details shown on the Drawings.

### 3.5 PAINTING

#### A. Shop Painting

All structural steel shall be shop primed in accordance with Section 33035 after fabrication and cleaning.

All steelwork shall be thoroughly cleaned of all loose mill scale, rust, and foreign matter before shop painting.

Each individual piece shall be painted before assembly. Paint shall be applied only to dry surfaces.

Edges where field welding is required shall not be painted.

#### B. Field Painting

After erection, the Contractor shall thoroughly prepare and clean the structural steel surfaces of all dirt, grease, rust or other foreign matter.

**\*\* END OF SECTION \*\***