

## **SPECIFICATION SECTION 07500 – REINFORCING STEEL**

### **TABLE OF CONTENTS**

1. DESCRIPTION.....	3
2. MATERIAL REQUIREMENTS .....	3
2.1 Reference Standards .....	3
2.2 Material for Reinforcing Steel .....	3
3. CONSTRUCTION REQUIREMENTS .....	4
3.1 Handling and Placing Reinforcement.....	4
3.2 Steel Quality and Supply .....	4
3.3 Bar Lists and Bending Diagrams .....	5
3.4 Fabrication .....	5
3.5 Fixing of Reinforcement Steel .....	5
3.6 Splicing of Bars.....	7
3.7 Splicing of Mesh or Mats.....	8
3.8 Testing frequencies.....	8
4. MEASUREMENT AND PAYMENT .....	8
4.1 Method of Measurement.....	8
4.2 Basis of Payment .....	9



## **SPECIFICATION SECTION 07500 - REINFORCING STEEL**

### **1. DESCRIPTION**

This Specification Section prescribes the requirements and provisions for the supply, bending, fabrication and placing of steel reinforcement of the type, size, shape and grade required in accordance with the Drawings as specified or as may be required by the Engineer.

### **2. MATERIAL REQUIREMENTS**

#### **2.1 Reference Standards**

The most recent edition of the following Standards shall be applied to the Works covered by this Specification Section. The equivalent Standards will only be accepted for items which the preferred Standard does not cover.

Preferred Standard (Vietnamese Standard):

TCVN 1651:2008	Steel for the reinforcement of concrete
22TCN 272-05	Standard for Bridge Design

Equivalent Standard (International Standard):

AASHTO M31	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
AASHTO T68	Standard Method of Test for Tension Testing of Metallic Materials
AASHTO M164M	High-Strength Bolts for Structural Steel Joints
AASHTO M232	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A153	Zinc-Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A185	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ACI 315	Details and Detailing of Reinforcement

#### **2.2 Material for Reinforcing Steel**

##### **2.2.1 Reinforcing Bars**

All Reinforcing Steel bars and deformed billet steel shall conform to Vietnamese Standard TCVN 1651:2008. In case items are not covered by TCVN 1651:2008 then AASHTO M31 (ASTM A615), Grade 60 or equivalent and AASHTO M31 (ASTM A615), Grade 40 for plain round reinforcing bars shall be used. Testing shall be in accordance with Vietnamese Standard TCVN 1651:2008 with AASHTO T68 as the equivalent standard. Unit stress calculations for bars having an area differing by 6 percent or more from the

nominal bar area shall be made using the actual measured bar area.

#### 2.2.2 Spiral Reinforcement Steel

Spiral reinforcement steel shall comply with the requirements of Vietnamese Standard TCVN 1651:2008 in reinforced concrete compression members.

#### 2.2.3 Substitution of different size

- a) Substitution of bars of different size will be permitted only upon the specific approval of the Engineer and the substitute bars shall provide a steel area equal to or larger than that called for in the Drawings.
- b) Number designated bars not equivalent in sectional area to bars with specified size in millimeters may be substituted with bars having the closest designated number and sectional area and their spacing shall be adjusted to provide the same area per unit spacing. Substitution of bars of which specified size in millimeters are not readily available from the Contractor's source may be made on the same basis. All bar substitutions shall be subject to the approval of the Engineer.

#### 2.2.4 Welded Steel Wire Fabric

Welded steel wire fabric shall comply with the requirements of ASTM A185 and shall be as indicated on the Drawings. Welded fabric shall be placed in accordance with the Manual of Standard Practices by the Concrete Reinforcing Steel Institute (CRSI).

### 3. CONSTRUCTION REQUIREMENTS

#### 3.1 Handling and Placing Reinforcement

All reinforcement steel shall be protected as far as practicable from mechanical injury or surface deterioration, from rusting or other causes from the time of shipment until it is placed. Reinforcement steel stored at the Site shall be laid on wood floors or cradles suitably spaced so that no reinforcement steel shall be laid upon or come in contact with the ground. When the weather is dry and the time for storage before installation is limited protection from the elements may be dispensed with but if rainy or exceptionally humid weather occurs or is anticipated the reinforcement shall be stored under cover.

#### 3.2 Steel Quality and Supply

- a) Representative samples of all reinforcement steel that the Contractor proposes to use in the Works must be submitted to the Engineer for his approval together with the manufacturer's certificates stating clearly for each sample; the place of manufacture, the expected date and size of deliveries to the Site, and all relevant details of composition, manufacture, strengths and other qualities of the steel before work is commenced.

- b) In the event a reinforcement steel sample under test fails to meet the specification requirements at any time or the Engineer considers that samples which were presented to him for test were not truly representative or if it becomes apparent that reinforcement steel which has not been approved has been used on the Works the Engineer may instruct the Contractor to break out and remove completely all such sections of the work already constructed using such suspect reinforcement steel.
- c) All testing of reinforcement steel bars shall meet the requirements of Vietnamese Standard TCVN 1651:2008 or ASTM/AASHTO as the equivalent standard.

### **3.3 Bar Lists and Bending Diagrams**

The Contractor shall provide detailed bar lists and bending diagrams to the Engineer for his review and approval. Fabrication and bending of reinforcement shall not begin until such lists and diagrams have been approved. Any expense incidental to the revision of material furnished in accordance with such lists and diagrams to comply with the Drawings shall be borne by the Contractor.

### **3.4 Fabrication**

#### **3.4.1 Bending**

Bar reinforcement shall be cut and bent to the shapes shown on the Drawings. Fabrication tolerances shall be in accordance with ACI 315. All bars shall be bent cold, unless otherwise permitted. Bars partially embedded in concrete shall not be field bent except as shown on the Drawings or as specifically permitted.

#### **3.4.2 Hooks and Bend Dimensions**

The dimensions of hooks and the diameters of bends measured on the inside of the bar shall be as shown on the Drawings. When the dimensions of hooks or the diameter of bends are not shown, they shall be in accordance with Article 5.10.2 of Vietnamese Standard 22TCN 272-05 Bridge Design Standard

### **3.5 Fixing of Reinforcement Steel**

- a) Reinforcement steel shall be assembled to the shapes and dimensions as indicated on the Drawings. The bars shall be of the cross sectional areas indicated and shall be fixed rigidly and accurately in the forms in the positions indicated on the Drawings. The bars shall be firmly bound together at intersections to ensure that the reinforcement framework as a whole shall retain its shape, and the framework shall be so temporarily

supported as to retain its correct position in the forms during the process of depositing and consolidating the concrete. The end of all tying wires shall be turned into the main body of the concrete and not allowed to project towards the surface. Spacing blocks shall be of precast concrete of strength at least equal to that of concrete being placed. They shall be as small as practicable and shall be securely fixed in position by means of wires cast into them. They shall be soaked with water immediately prior to concreting.

- b) No temporary metal supports to the reinforcement steel will be allowed to be incorporated in the finished concrete and metal clips or supports shall not be placed in contact with forms for exposed surfaces. Use of plastic supports will not be allowed.
- c) Clear cover for all reinforcement shall be as indicated on the Drawings. Where no cover is indicated the minimum cover of 50mm shall be maintained unless the Engineer approves deviations otherwise.
- d) At the time of concreting all reinforcement steel shall have been thoroughly cleaned and free of all loose rust, scale, mud, oil or any other coatings that might destroy or reduce the concrete bond and it shall also have been cleaned of all set or partially set concrete which may have been deposited during previous concreting operations.
- e) The placing of all reinforcement steel bars shall be checked by the Engineer and in no case shall concrete be placed around any reinforcement steel that has not been approved by the Engineer. The insertion of bars into, or the removal of bars from concrete already placed, will not be permitted. Reinforcement steel temporarily left projecting from the concrete at the joints shall not be bent without the prior approval of the Engineer.
- f) Dowels shall project a minimum of 40 bar diameters unless otherwise indicated on the Drawings. Metal supports which extend to the surface shall not be used. Placing bars on layers of fresh concrete as the work progresses and adjusting bars during the placing of concrete will not be permitted.
- g) Main reinforcement steel carrying determined stresses shall be spliced only where indicated on the Drawings or on the approved shop drawings.
- h) The minimum spacing centre to centre of parallel bars shall be 2.5 times the diameter of the bar, but in no case shall the clear distance between the bars be less than 1.5 times the maximum size of the coarse aggregate in the concrete.
- i) Bundled reinforcement shall be tied together at a spacing not exceeding 1.80 meters.

### 3.6 Splicing of Bars

All reinforcement shall be furnished in full lengths as indicated on the Drawings unless otherwise approved by the Engineer. Except for splices shown on the Drawings and splices for 16mm or smaller bars, splicing of bars will not be permitted without the approval of the Engineer. Splices shall be staggered as far as possible.

#### 3.6.1 Lapped Splices

Lapped splices shall be of the lengths shown on the Drawings. If not shown on the Drawings, requirements for lapped slices shall be in accordance with Article 5.10.3 of the Vietnamese Standard 22TCN 272-05 Bridge Design Standard. The bars in lapped splices shall be placed and wired in such as manner as to maintain the minimum concrete cover and the minimum spacing between the bars as detailed in this Specification Section.

#### 3.6.2 Welded Splices

Welded splices shall be used only if specified on the Drawings or if approved by the Engineer. Where approved welding shall conform to the Structural Welding Code, Reinforcing Steel, AWS D1.4 of the American Welding Society and applicable special provisions. Welding of reinforcement steel will be allowed if the chemical composition of the steel exceeds the percentages shown in Table 1.

Table 1 Reinforcing Steel Components

Chemical Composition	Percent
Carbon (C)	0.30
Manganese (MA)	1.50
Carbon Equivalent (CE)	0.55

#### 3.6.3 Mechanical Joint (Coupler Type)

- Splices made with mechanical couplers shall be used only if detailed on the Drawings or previously approved by the Engineer in lieu of welding. Such couplers shall develop in tension or compression as required, at least 125 percent of the specific yield strength of the bar.
- When requested by the Engineer, up to two field splices out of each 100, or portion thereof, placed in the work and chosen at random by the Engineer, shall be removed by the Contractor and tested to 125 percent of the specified yield strength.
- Tensile failure must be occur in the bar away from the joint
- There must be no reduction of the nominal cross section area of the parent bar.

- e) Couplers must be marked to allow full traceability of the material.
- f) Couplers connecting bar reinforcement embedded in existing structures to other bar reinforcement should meet the performance criteria set out in subsection 3.6.3(a) above.
- g) Mechanical Joint by threaded coupler splice shall be applied to rebar more than D36.

### 3.7 Splicing of Mesh or Mats

Sheets of mesh or bar mat reinforcement shall be spliced by overlapping sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The lap shall not be less than one mesh in width plus 50 mm.

### 3.8 Testing Frequencies

Testing frequencies (using for material testing) shall be accordance with Vietnamese Standard: TCVN 1651-2008 as shown on Table 2 or other international standard subject to equivalence being demonstrated by the Contractor to the satisfaction of the Engineer:

Table 2 Testing Frequencies

Item	Test Description	Reference Article	Remark
1	Plain bar.		
	Material testing: (for material approval)		
	-Sampling & method for testing	Article 11.3.2.2	
	-Other testing & frequency for testing	Article 11.3.3	
2	Ribbed bar.		
	Material testing: (for material approval)		
	-Sampling & method for testing	Article 8; 9	
	-Other testing & frequency for testing	Article 12.3.3	

Source (Vietnamese Standard):

TCVN 1651-1: 2008: Steel for reinforcement of concrete - Plain bar and  
TCVN 1651-2: 2008: Steel for reinforcement of concrete – Ribbed bar.

## 4. MEASUREMENT AND PAYMENT

### 4.1 Method of Measurement

- a) Reinforcing Steel shall be measured for payment in metric tons for both deformed bars and plain bars based on the total computed weight for the sizes and lengths of bars (including laps) as indicated in the reinforcing schedules on the Drawings and installed to the approval of the Engineer.
- b) The Reinforcing Steel provisions, material requirements and construction requirements identified in this Specification Section shall be measured for payment in pay items 07500-01, 07500-02 and 07500-03.
- c) Any Reinforcing Steel Works not specifically identified in this Specification Section but which are necessary for the performance of the Works shall be deemed to be included in pay items 07500-01, 07500-02

and 07500-03.

- d) The reinforcing steel for bored piles and precast prestressed concrete “I” girders is included in the unit rates for those items measured for payment in Specification Sections 07300 Bored Pile and 07400 Prestressed Concrete.

#### **4.2 Basis of Payment**

- a) The work under this Specification Section shall be paid for in accordance with the applicable unit prices as indicated in the Bill of Quantities and given below. Payment shall constitute full compensation for performing the requirements of the Contract for the item of work as specified including furnishing all necessary labor, materials, tools, equipment and incidentals.
- b) No separate payment shall be made for clips, wires, separators, wire chairs, and other material used in fastening the reinforcement in place. In the event that bars are substituted upon the Contractor’s request and as a result more steel is used than specified only the amount specified shall be included in the quantity for payment.
- c) The additional material required for splices made for the convenience of the Contractor indicated on the shop drawings shall be included in the unit prices of the Contractor.
- d) For computing the weight of reinforcement steel bars for payment the Contractor shall be comply with the Standard Unit Weight Table provided according with Vietnamese Standard TCVN 1651: 2008 as shown on Table 3 and Table 4.

Table 3– Vietnamese Standard TCVN1651-1:2008  
(Steel for the reinforcement of concrete–part 1: Plain bar)

Title diameter mm	Cross section area mm <sup>2</sup> , A <sub>n</sub>	Theory quantity of 1m length	
		Requirement (kg/m)	Tolerance (%)
6	28.3	0.222	±8
8	50.3	0.395	±8
10	78.5	0.617	±6
12	113	0.888	±6
14	154	1.21	±5
16	201	1.58	±5
18	254.5	2.00	±5
20	314	2.47	±5
22	380	2.98	±5
25	490.9	3.85	±4
28	615.8	4.83	±4
32	804.2	6.31	±4
36	1017.9	7.99	±4
40	1256.6	9.86	±4
$A_n = 0.7854 \times d^2$ Unit weight per length = $7.85 \times 10^{-3} \times A_n$			

Table 4– Vietnamese Standard TCVN1651:2008  
(Steel for the reinforcement of concrete – part 2: Ribbed bar)

Title diameter mm	Cross section area mm <sup>2</sup> , A <sub>n</sub>	Theory quantity of 1m length	
		Requirement (kg/m)	Tolerance (%)
6	28.3	0.222	±8
8	50.3	0.395	±8
10	78.5	0.617	±6
12	113	0.888	±6
14	154	1.21	±5
16	201	1.58	±5
18	254.5	2.00	±5
20	314	2.47	±5
22	380.1	2.98	±5
25	491	3.85	±4
28	616	4.84	±4
32	804	6.31	±4
36	1017.9	7.99	±4
40	1257	9.86	±4
50	1964	15.42	±4

If diameter of ribbed bar is greater than 50mm, it is recommended to have agreement between manufacturer and purchaser, and tolerance allowable for each ribbed bar must be ±4%

$A_n = 0.7854 \times d^2$

Unit weight per length =  $7.85 \times 10^{-3} \times A_n$

<u>Pay Item</u>	<u>Description</u>	<u>Unit</u>
<b>07500</b>	<b>Reinforcing Steel</b>	
07500-01	Reinforcing Steel (D ≤ 10mm)	ton
07500-02	Reinforcing Steel (10mm < D ≤ 18mm)	ton
07500-03	Reinforcing Steel (18mm < D)	ton