

Section 26 - Reinforcement Steel Details

26.1 Reinforcement Presentation

1. Soft Metric Reinforcing Bars

Due to the past requirement of providing contract plans in metric units, the reinforcement steel industry shifted to stamping of reinforcement in soft metric size designations. As advised by the Concrete Reinforcing Steel Institute (CRSI) this practice is to continue for the foreseeable future.

Accordingly, it is important for Designers to be aware of this practice with respect to the detailing of soft metric reinforcing bars on contract plans. The term "soft metric" is used in the context of bar sizes and bar size designations. "Soft metric conversion" means describing the nominal dimensions of inch-pound reinforcing bars in terms of metric units, but not physically changing the bar sizes. In 1997, producers of reinforcing bars (the steel mills) began to phase in the production of soft metric bars. Within a few years, the shift to exclusive production of soft metric reinforcing bars was essentially achieved. Virtually all reinforcing bars currently produced in the USA are designated in soft metric units. Thus, USA-produced reinforcing bars furnished to any construction project will be in a soft metric designation. Therefore, to be consistent with what is delivered to Department projects, plan development must detail soft metric bar sizes.

Designation of Bar Sizes. The sizes of soft metric reinforcing bars are physically the same as the corresponding sizes of inch-pound bars. Soft metric bar sizes, which are designated #10, #13, #16, and so on, correspond to inch-pound bar sizes #3, #4, #5, and so on. The metric bar designations are simply a re-labeling of the inch-pound bar designations. The following table shows the one-to-one correspondence of the soft metric bar sizes to the inch-pound bar sizes.

Soft Metric Bar Sizes Vs. Inch-Pound Bar Sizes

Soft Metric Bar Size Designation	Inch-Pound Bar Size Designation
#10	#3
#13	#4
#16	#5
#19	#6
#22	#7
#25	#8
#29	#9
#32	#10
#36	#11
#43	#14
#57	#18

Minimum Yield Strengths or Grades. Virtually all steel mills in the USA are currently producing reinforcing bars to meet the metric requirements for tensile properties in the ASTM specifications. Minimum yield strengths in metric units are 300, 350, 420 and 520 Mpa (megapascals), which are equivalent to 40,000,

50,000, 60,000 and 75,000 psi, respectively. Metric Grade 420 is the counterpart of Standard Grade 60.

Bar Marking. Soft metric reinforcing bars are required to be identified with the Producer's mill designation, bar size, type of steel, and minimum yield strength or grade.

Based on the fact that industry produces reinforcement steel bars in a metric size designation, Designers must indicate the metric bar size in plan sheet detailing. The following guidance shall also be followed in plan sheet preparation.

- a.) On any plan sheet that presents the drawings for a portion of a bridge structure, such as a pier, all reinforcement bars pertinent to that pier shall be detailed and billed on that sheet (see Subsection 26.2 g. below).
- b.) The same designation shall not be used to detail reinforcement steel that is of a different size, length or shape and that is to be placed in a substructure element or in a superstructure.
- c.) When detailing lengths of reinforcement bars, consideration must be given to transportation and handling, and where extremely long lengths are contemplated, to availability and special orders.
- d.) All sizes of bars are readily available in lengths up to 60 feet. However, #10 and #13 bars more than 40 feet long tend to bend in handling; therefore, they should be avoided. Sizes #16 through #57 in lengths exceeding 60 feet can be rolled at mills by special order. Seventy (70) feet should be considered the practical limit in any circumstance.
- e.) When the location of bar splices is arbitrary, as in the case of the longitudinal reinforcement of deck slabs on stringers, the following maximum lengths are preferred:

#19 bars and up.....	50'-0"
#16 bars.....	39'-0"
#13 bars	30'-0"

2. Provide corrosion protected reinforcement for the following components:
 - Deck slab, top and bottom mat
 - Sidewalks, parapets, median barriers
 - Haunch area
 - Mild reinforcement in prestressed box and slab beams and in prestressed concrete beams
 - Abutment backwall
 - Grillage reinforcement in abutments and piers
 - Footings dowels in corrosive environments
 - Integral abutment relief slabs and sleeper slabs
 - Precast culverts, precast arch and 3-sided precast culverts – top mats if fill is less than two feet
 - Cast in place culverts – top and bottom mats if top slab is used as riding surface
 - Bottom one third of noise barrier panels, noise barrier posts and footing if located within roadway splash zone
 - Pedestals and barrier pedestals of sign support structures

The above list shall not be considered all inclusive. The Bridges and Structures Design Manual should be studied for thorough guidance. Engineering judgment should also be used to aid in identifying where corrosion protected reinforcement may be helpful in protecting other components of the structure.

3. The current types of corrosion protected reinforcement permitted include the following:

- Epoxy coated
- Galvanized
- Stainless steel
- Stainless steel clad

While it is understood that epoxy coated reinforcement is most commonly used, a Designer should evaluate site specific locations to assess if components of a bridge may warrant use of either of the other types stated above. The other types may be considered to be more worthy of achieving service life longevity.

26.2 Reinforcement Designation

1. To provide uniformity in all bridge plans, the following rebar designations shall be used:

AAbutments

C.....Culverts

D.....Dowels

F.....Footings

P.....Piers

S.....Deck Slabs

SS.....Sidewalks

PP.....Parapets

Use additional prefix letter or number when needed, i.e., NA for North Abutment, EA for East Abutment, 1 for Span 1, 2 for Pier 2, etc.

2. The following illustrates detailing notations:

25 - #16 - F1@ 18"

20 - #16 - W2 @ 18"

18 - #16 - W3 @ 18"

20 - #16 - 1S2 @ 6"

20 - #16 - 2S3 @ 6"

3. Explanation of abbreviations shall be noted on the plans.

Legend

(FF) Indicates Front Face

(RF) Indicates Rear Face

(T) Indicates Top

(B) Indicates Bottom

4. If it becomes necessary to provide varying length reinforcement bars to accommodate a flared condition on any part of a structure, do not detail the bars in a table of small increment changes in length; detail the bars in groups of the same length to accommodate the flare by variance of lap. All bars in the same group shall carry the same bar designation.
5. Bars may be detailed to the closest 1 inch of length and the mass of reinforcement bars shown in the Bill of Material shall be to the nearest ten (10) pounds.
6. The dimension of all laps shall be shown on the plans.
7. The Bill of Material shall be in the following form:

Reinforcement Steel – Pier #1				
No.	Mark.	Size	Length	Remarks
24	1P1	#25	15'-5"	Detailed
12	1P2	#25	30'-0"	Straight

When epoxy coating is required on rebars, "Epoxy Coated" shall be noted in the **Remarks** column.

When galvanizing is required on rebars, "Galvanized" shall be noted in the **Remarks** column.

When stainless steel is required on rebars, "Stainless Steel" shall be noted in the **Remarks** column.

8. Bent bars shall be detailed with complete dimensions. Hooks and bends shall conform to CRSI practices.
9. Other reasonable systems of bar designations will be considered for approval on an individual basis.
10. The Designer shall designate which corrosion protective system is to be used. Mixing of corrosion protection types in a single structural unit should be avoided.