

**Drafting and Design Presentation Standards
Volume 3: Structural Drafting Standards**

Chapter 3: Concrete and Reinforcement Detailing

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Chapter 3 Amendments

Revision register

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1	-	First issue	Manager (Structural Drafting)	Apr 2011
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	3.12	Grade of bar for wire and square bar removed		

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3 Concrete and Reinforcement Detailing

3.1 Glossary of terms

For a complete glossary of terms refer Chapter 1-*Introduction*.

3.2 Figures and examples shown in this volume

The figures and examples shown in this volume are for presentation purposes only, and may contain some details that are now superseded. These details have been included for ease of reference, to illustrate typical solutions, and to show the required standard of drafting presentation. The details are not to be used without an engineering check and certification by a Structural RPEQ to confirm that the details are appropriate for the specific project.

3.3 Concrete detailing

Concrete detail drawings should show the physical dimensions and heights of a concrete structure. It is important that sufficient information is shown to enable formwork to be built and erected and concrete quantities to be easily calculated.

Formed holes, cast-in steel work, construction joints and any necessary layers of blinding concrete shall be shown.

The location of formed holes and cast-in steel work shall be sufficiently dimensioned to enable their correct positioning inside the formwork.

Cast-in items, where applicable, shall be cross referenced to the drawing that shows its fabrication details.

3.4 Symbols and line work for concrete

Where necessary sectional views may be hatched with the relevant material symbol. Refer Chapter 2-*Standard of Presentation*, Table 2.5.1-Line Styles and Chapter 2-*Standard of Presentation*, Table 2.13.1 - *Material Symbols*.

The full cutting plane may be hatched however care needs to be taken not to hide any pertinent details on that view. If hatching is necessary but there are other relevant details on the view that are needed, part hatching is advised.

Hatching is to be avoided on sections showing reinforcement as it can lead to the reinforcement being obscured on the view.

3.5 Dimensioning

Dimensioning of concrete items shall be in accordance with Chapter 2-*Standard of Presentation*, 2.9- Dimensions.

3.6 Plan views

Plan views showing the location of such elements as footings, columns, headstocks and the like, may also be used to show reference markings, co-ordinates and chainages. Plan views shall be drawn as a view seen from a horizontal plane taken immediately above the element under consideration.

Hidden details such as piles, columns and footings shall be shown as dashed lines where appropriate in accordance with Chapter 2-*Standard of Presentation*, 2.5-Linework.

3.7 Elevations

Elevations shall be drawn as a view seen from a vertical plane immediately in front of the element under consideration and shall be projected from that elements plan view.

Hidden details, such as abutment wing walls and associated fillets and the like, are not required to be shown unless that part of the structure is referenced by a height or a dimension. Hidden detail lines are to be in accordance with Chapter 2-*Standard of Presentation*, 2.5-Linework.

3.8 Sections

Sections shall be drawn in accordance with Chapter 2-*Standard of Presentation*, 2.7-Sections Views and Details.

3.9 Holes in concrete structures

Holes required in concrete structures are either cast during construction, or are created in existing structures when needed. Holes are identified on drawings by the manner in which they are formed.

On bridge drawings there are three main types of holes.

1. Formed holes

There are two methods of creating formed holes in concrete.

By fixing a sacrificial block (of the required cross section) into the formwork of a structure to be cast, such that after casting, the block is removed (or sacrificed) leaving the area as a void in the element. The most common example is deck unit holding down bolt holes in headstocks.

By fixing a hollow pipe in the formwork so that it forms a permanent liner to the hole after casting, for example, the scupper holes in deck units.

2. Cored holes

Cored holes are created in existing structures by the use of a coring drill. The centre piece is removed as a circular core leaving a smooth sided hole in the structure. Cored holes are usually used when large hole diameters are required. Examples of cored holes in bridge work are holes through concrete elements for the attachment of footwalk frames, services brackets and replacement bridge traffic rails.

3. Drilled holes

Drilled holes are formed by drilling with a spiral bit or rotary hammer into existing structures, for example, to bond new reinforcement into an existing headstock to facilitate an extension. Drilled holes with their rough surface provide a better bond for epoxy than cored holes do.

3.10 Symbols and line work for reinforcement

Reinforcing bars are to be shown on the drawings in accordance with Table 3.10-1 - Symbols and Line Work. Note: Bars shown in section should be drawn 1.5 x scale, where necessary, to improve clarity when reduced to A3 size. Alternatively they may be drawn in a 1 mm thick pen.

Refer Chapter 2-*Standard of Presentation*, Table 2.5-1 - Line Styles for line styles and AutoCAD layers. Hatching is to be avoided on sections showing reinforcement as it can lead to the reinforcement being obscured on the view.

Table 3.10-1 - Symbols and Line Work

DESCRIPTION	EXAMPLE
Bar bent toward observer	
Bar bent away from observer	
Hooked bar in elevation	
Hooked bar in plan	
Bar lapped inside	
Bars lapped (same plane)	
Bar lapped (cranked)	
Bar or stressing strand in section	

1.5 x scale, where necessary

3.11 Reinforcement detailing

Elevations, Plans and Views shall be treated as being transparent with the applicable reinforcement details being added.

Reinforcing details shall be in accordance with TMR Standard Drawings 1043 - Standard Bar Shapes and 1044 - Standard Hook Lap and Bend Details and General Steel Reinforcement Information.

3.12 Reinforcing bar identification

Reinforcing bars are nominated on drawings using the following convention: 11–16A15R at 150

Where

- 11 = number of identical bars
- 16 = diameter (mm) of the bar
- A = bar shape
- 15 = sequence number of the bar
- R = grade of bar
- 150 = maximum design spacing of reinforcing bars.

“at” may be replaced with “@”, however the presentation should be similar throughout the entire drawing.

Bar shapes – standard

Included in TMR Standard Drawing 1043 is a standard set of bar shapes. All standard bar shapes are to be identified in accordance with this drawing. The standard bar shapes letters on this drawing are reserved for these shapes. Non-standard bar shapes must use different letters.

When steel schedules are not part of the bridge contract documentation, enough information shall be shown on the drawings to define these bars for future steel scheduling.

Bar shapes – non-standard

Bars shapes that are not detailed on TMR Standard Drawing 1043 are non-standard bars and must be fully detailed. Refer Chapter 4-*Computer Preparation of Steel Schedules*.

Sequence numbers

Sequence numbers are to be allocated in accordance with the following:

- numbers are to be assigned in ascending order starting at bar number one for each element of the bridge, for example, abutments, piers, cast insitu decks etc.
- numbers are to advance in order of placement in the structure i.e. from bottom to top
- sequence numbers are not to be duplicated in any element unless the bars are identical.

Grade of bar

D – Grade D500N (deformed bars)

R – Grade R250N (round bars)

The grade of bar is not shown if the bar is Grade D500N, for example 11–16A15 at 150.

The grade of bar shall align to AS/NZS 4671 - Steel Reinforcing Materials.

3.13 Presentation

Calling up and labelling

Bars are to be called up along a line between limit bars or by arrows to individual bars.

Where a dimension is required to show the distance between the first bar and the last bar of the sequence, the bars shall be called up as follows:

- 11–16A15 at 150 maximim = 1400

The number of bars required for any set is to be called up once only on the drawing, preferably on the main view, for example if the number of bars in the set is called up on the elevation, that number is then omitted from the other views.

Each bar shall be shown in at least two views on any drawing. Refer Figure 3.13-1 - Typical Reinforcement Detailing.

Fitment

Drafters are to ensure that the drawings accurately show a clear picture of the fitment of reinforcing bars relative to any recesses, cast-in items, or any other obstruction that may be present in any concrete element which is being detailed.

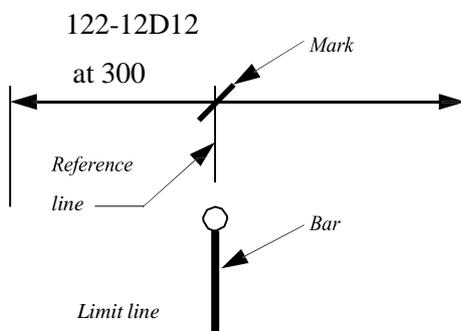
All views shall be drawn to scale, where possible, especially where clearances are critical. Hooks, laps and bends are to be drawn to scale as there can be clashes between ligatures and voids, recesses, cast-in items and the like. These clashes are readily identified if drawn to scale.

When interference is of a minor nature and not critical, for example the placing of shear reinforcement, a suitable note is to be added to the drawing. For example, *Spacing of ligatures in headstock may be altered slightly, if necessary, to clear formed holes.*

Dimensioning

Dimensions on drawings shall be taken as follows unless clearly shown otherwise:

- spacing is bar centre to bar centre
- cover is to the extremity of the designated bar
- the extent of the reinforcement is to be shown by limit lines. These are represented by a 5 mm long, 0.7 mm thick line (A1 drawing). The dimension line is to be 3 mm from this limit line
- a reference line and mark is to be drawn from the bar to the dimension line in all instances. The mark is to be at 45 degrees to the reference line starting at bottom left and finishing at top right (looking normal to the text). The mark shall be a 5 mm long, 0.7 mm thick line (A1 drawing).



Laps and anchorage lengths

Standard laps and anchorage lengths for all horizontal reinforcement shall be multiplied by 1.25 when there is greater than 300 mm of concrete below the bar. The laps shall be shown on the drawings. Refer Figure 3.13-1 - *Typical Reinforcement Detailing*.

If laps are not specified by the designer the lengths shall be shown in accordance with TMR Standard Drawing 1044.

Multi layered reinforcement

Where multiple layers of the same reinforcement are to be detailed, for example faces of deck slabs or walls, the following nomenclature is to be used:

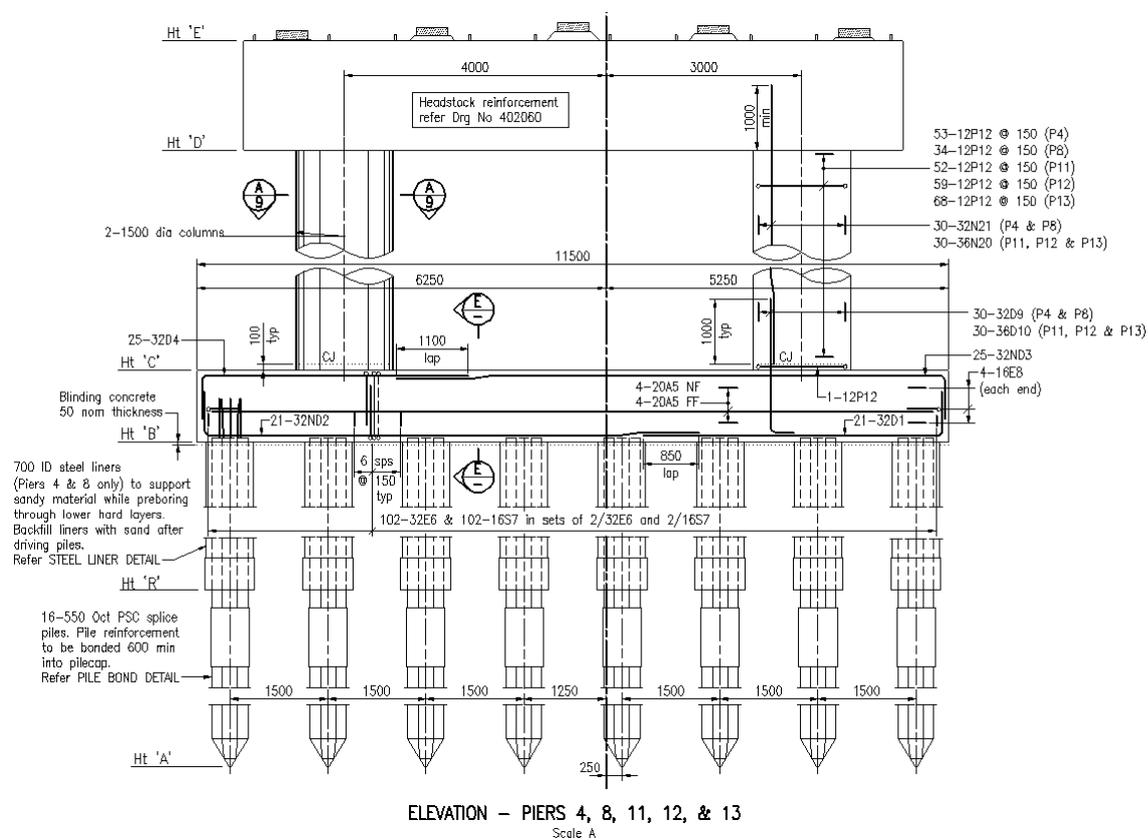
- NF (near face)
- FF (far face)
- T (top face)
- B (bottom face)
- C (central face).

Using the nomenclature EF (each face) can be confusing and may lead to inaccuracies in quantity calculations, therefore its use is not permitted. For example, writing 8-12A1 EF may be confusing. Are there eight bars on the NF and eight on the FF? Writing 4-12A1 NF and 4-12A1 FF leaves no room for error.

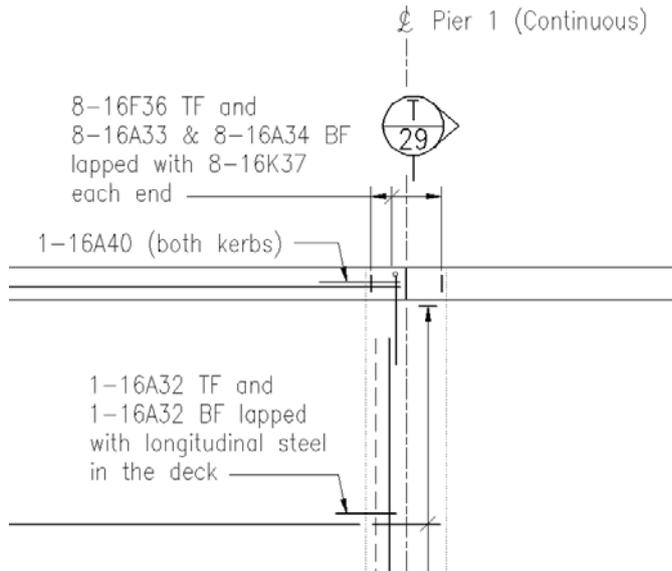
Sections

Stirrups and ligatures shown in section shall be drawn to clearly show the shape of the bar. For typical details for lap and anchorage lengths, spacing of reinforcement, multilayered reinforcement and sections, refer to the four diagrams in Figure 3.13-1 - Typical Reinforcement Detailing.

Figure 3.13-1 - Typical Reinforcement Detailing



Lap and Anchorage Lengths

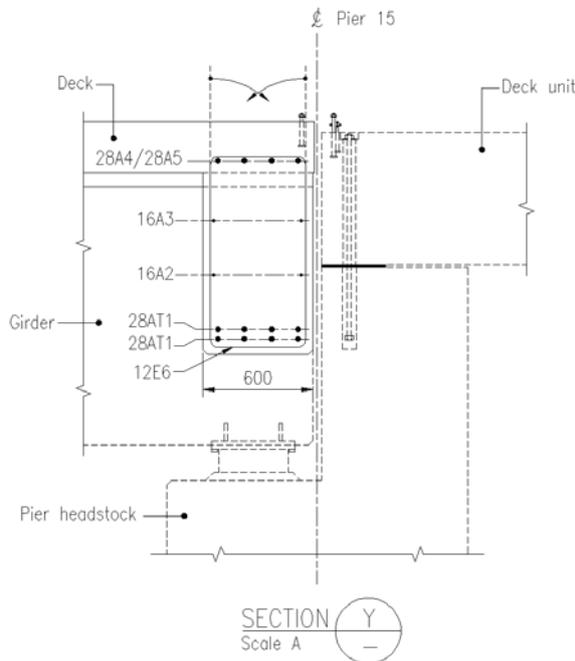


PLAN – DECK
Multilayered Reinforcement

Bars bent on site

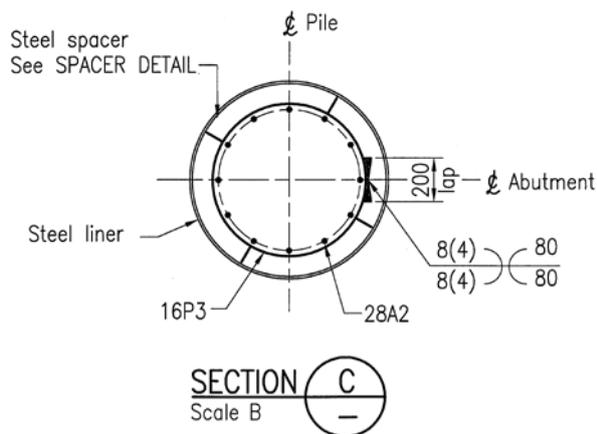
Bars to be bent on site are to be clearly shown on the drawings by a note indicating that a site bend is necessary and that approved safety caps are to be used if the protruding reinforcement is not hooked. Refer Figure 3.13-2 - Bars Bent On Site.

Figure 3.13-2 - Bars Bent On Site



Welded laps of reinforcement

The size and length of the weld required is to be shown on the drawings. For P and SD shaped bars the weld details shall match those shown on TMR Standard Drawing 1043. Refer Figure 3.13-3 - Welded Laps.

Figure 3.13-3 - Welded Laps

The same information will be shown automatically on the output of the reinforcing steel schedule. Refer Chapter 4-*Computer Preparation of Steel Schedules*.

Multiple laps

If a bar requires one or more laps, it is to be called up on the drawings in the usual fashion. The details of the laps are to be entered in the steel schedule. Refer Chapter 4-*Computer Preparation of Steel Schedules*.

Spiral reinforcement – bar shape Q

Spiral reinforcement used in cast in place piles shall conform to the following requirements:

- bar diameter no greater than 16 mm
- spiral diameter no greater than 2 m
- 1.5 turns anchorage each end of spiral
- laps to be a minimum of 50 times bar diameter.

The spirals are to be identified as bar shape Q in the steel schedule and will include the following details:

- the finished length, dimension C, is to include 2 x 1.5 turns (three pitches) added to the required length. For example, a spiral 10 m long with a pitch of 100 mm shall be scheduled as being 10.3 m long
- if the bar length is greater than 12 m, the following note is to be added on the drawing and in the steel schedule on a comment line: Laps in spiral to be 50 times bar diameter. Bar length does not include extra length required for laps.

The following note shall point to the Q shaped bar on the relevant drawing: Supplied spiral to be adjusted on site to achieve anchorage at each end of 1.5 turns. Laps in spiral to be 50 times bar diameter.

Coupled reinforcement

Structures which are cast in stages or provide for future extensions often require reinforcing bars to be coupled together when the subsequent stage is constructed.

In such cases special notation is required to be shown on the drawings and the steel schedule. The note on the drawing shall be placed adjacent to the elevation where the bars are shown and shall state: Screwed couplers to be used to couple reinforcement between Stage 1 and Stage 2.

Notes on the steel schedule shall be placed on comment lines adjacent to the respective bars and shall state for Stage 1: Bar numbers to be supplied at one end only with an approved screwed coupler. Dimension 'A' includes coupler and plastic end cap.

For Stage 2: Bar numbers are to connect to Stage 1 screwed couplers. Dimension "A" is measured from construction joint to end of bar. The actual dimension needs to be adjusted to suit the coupler system used in Stage 1. Lengthening or shortening of the bar to conform to manufacturer's specifications. Thread type and length may change depending on screwed coupler system used. Thread to conform to manufacturer's specifications.

3.14 Maximum cutting length of reinforcing bars

The maximum cutting length of steel reinforcing bars is 12 m and has been determined allowing for availability of standard lengths and for practical handling purposes during transportation and placement of the reinforcement.

3.15 Maximum leg length

When designing reinforcement bar shapes, consideration shall be given to the practicality of bending the bar. Bending a bar with a long leg length may not suit the bar bending equipment at some factories. Often, safety fences are positioned around the bar bending machine, and the leg may hit the fence. For these reasons, the leg length should be limited to 1.4 m wherever possible. This can usually be achieved by putting addition straight bars and laps in the reinforcement.

Refer Figure 3.15-1 Maximum Leg Length.

Figure 3.15-1 - Maximum Leg Length

