Drafting and Design Presentation Standards
Volume 3: Structural Drafting Standards

Chapter 15: Prestressed Concrete Deck Units

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Chapter 15 Amendments

Revision register

Issue/Rev No.	Reference Section	Description of Revision	Authorised by	Date
1	–	First Issue.	Manager (Structural Drafting)	April 2011
2	–	Document name change.	Manager (Structural Drafting)	Feb 2012
	15.5	Table deleted – refer STD drawings for dimensions and strand details		
	15.8	Add formwork kick details to Table 15.8-1. Update Figure 15.8-4. Remove figures for bridge traffic barrier post.		
	15.9	Recess depth increased to 55 mm. Remove figures for deck unit layout.		
	15.10	Update Figure 15.10-1.		
3	15.3	Delete references excluding PSC Kerb Units	Team Leader (Structural Drafting)	December 2015
	15.4	Delete 20152 reference to ‘std drawings in development’		
	15.5	Section deleted – following sections renumbered		
	15.6 (was 15.7)	Reference added to nominal unit lengths for standard spans to ensure designs use standardised lengths where practical		
	15.7	TMR Standard Drwing 2042 (was 1519) Figure 15.7-1 revised Figure 15.7-2 and 15.7-3 – clearer images inserted Dimensions of bearing plates. Foamwork and services anchors not to be placed over transverse stressing holes. 20YC bars deleted – in process of removing from Standard Drawings. Figure 15.7-5 changed to match std unit drawings		

Issue/Rev No.	Reference Section	Description of Revision	Authorised by	Date
3 cont.	15.8	Reference to deletion of HD bolts / dowels deleted as braking force distribution requires all bolts in place Holding Down Bolt Hole Setting Out for Fixed and Continuous Decks: size of hold down bolt recess deleted – shown on std drawings.	Team Leader (Structural Drafting)	December 2015
	15.9	Reference to Chapter 17 – Deck Design Sketches deleted.		
	15.11	Figure 15.11-2 added		
	15.12	Change to Less than 30deg skew = skewed ligatures to match Figure 15.12-1 and 15.12-2		
	15.14	Scuppers on overpass bridges, Incorrect wording deleted		
	Appendices	Example Deck Units Standard Drawings Deleted – refer published drawings		

Contents

15 Prestressed Concrete Deck Units

15.1 Glossary of terms

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

15.2 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figures and examples shown in this volume are for presentation purposes only, and may contain some details that are now superseded.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.

15.3 General

This chapter will be expanded as further departmental standard deck unit drawings are developed. This chapter is read in conjunction with MRTS74 *Supply and Erection of Prestressed Concrete Deck and Kerb Units*.

PSC deck units are 596 mm wide. This unusual dimension has evolved from the imperial deck unit predecessor being 1′ 11 ½ ″. Deck units greater than 13 m in length contain polystyrene voids to reduce their weight. The voids have 75 x 75 mm fillets to ensure adequate cover to the hooks on the reinforcing steel, and to provide better flow of concrete during placement. Strands shall have a minimum of 60 mm cover to the voids.

15.4 Standard Drawings

A number of Standard Drawings are published for PSC Deck Units

The standard deck unit drawings shall be used as the basis for project drawings to ensure consistency in presentation and detail, to ensure production costs are minimised, and productivity of the precast industry is sustained. The design assumptions for the standard deck unit drawings are stated in TMR Standard Drawing 2042 – *Precast Unit - Design Assumptions for Transversely Stressed Standard Deck Units*. Further engineering checks will be needed if a project does not comply with these design assumptions.

Deck unit bridges with a RC deck will need project specific deck unit design. Refer 15.13 *RC Deck on Deck Units*.

15.5 Drilling Holes into Deck Units

Drilling holes into deck units is not permitted, for example, ferrules for installation of signs and other accessories, and presents a major structural risk from both cutting of strands and/or ligatures, and structural integrity of the connection. It is also a risk to the durability of the deck unit. The following text shall be shown on the General Arrangement drawing besides the section deck detail '*DRILLING INTO THE DECK UNITS IS NOT PERMITTED. ALL FERRULES/ATTACHMENTS MUST BE CAST-IN*'.

15.6 Constructability

Efficiency of precast production relies on the ability to implement a daily casting schedule. The design of individual units, with minor variations in length and/or skew, is not efficient to precast and significantly increases manufacture costs and increases delays in project delivery. Therefore, the

following conditions shall apply when setting out complicated horizontal geometry for deck unit bridges:

- wherever possible, use the departmental standard deck unit drawings. Variations from details shown on the drawings will not be permitted without the approval of the Deputy Chief Engineer (Structures)
- formwork anchor details shall always comply with the details on the standard drawings; additional anchors may be added when services are attached
- minimise the number of variations in skew
- minimise the number of variations in deck unit length.
- Lengths of units shall generally be 9950 for a 10 m span, 11950 for a 12 m span and so on.

15.7 Presentation

All deck unit drawings for departmental bridges are to be presented in a similar manner to the standard drawings.

Referenced documents and the note '*THIS DRAWING TO BE READ IN CONJUNCTION WITH STANDARDS DRAWING 2042 – PRECAST UNIT - DESIGN ASSUMPTIONS FOR TRANSVERSELY STRESSED STANDARD DECK UNITS*' are not required on project drawings.

The notes shown on the standard drawings shall be replaced with those shown in Chapter 5 – *Notes, 5.8 PSC Deck Unit Notes*.

In addition to the details shown on the standard drawings, the following details shall be added to project drawings:

- Deck Unit Schedule
- Transverse Stressing Unit Schedule.

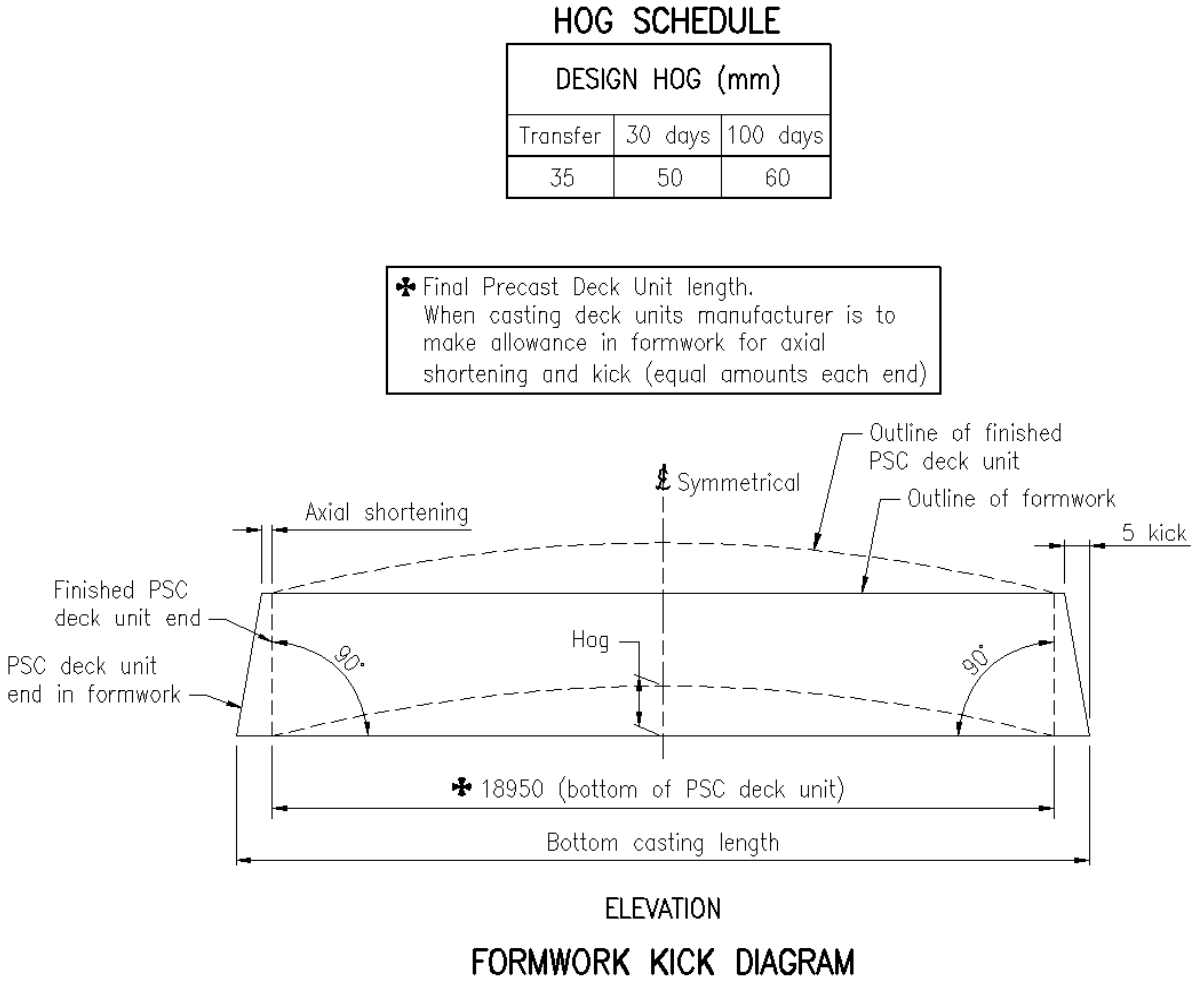
Design Hog and Formwork Kick of Deck Units

Hogs and formwork kick are to be shown in a table on the drawings. The formwork kick shall be calculated to ensure that the ends of the deck units are vertical at 100 days. The hog shall be shown at three stages after the deck unit is cast so that it can be measured progressively to check that it is hogging as designed. The design hog shall be shown:

- at transfer
- at 30 days
- at 100 days.

The 100 day hog is used to calculated bridge geometry. Refer Figure 15.8-1 *Design Hog of Deck Units*.

Figure 15.7-1 Design Hog of Deck Units



Deck Unit Schedule

A schedule for the deck units is to be shown in a table on the drawings.

The schedule shows the number of each deck unit type, the mass of each deck unit type, and the combined mass of each deck unit type. For deck unit mass calculations, the specific density of 2.6 tonnes/m^3 shall be used for inner deck units (without starter bars) and 2.7 tonnes/m^3 for outer deck units, and those supporting an RC deck (with starter bars).

Refer Figure 15.7-2 *Deck Unit Schedule*.

Figure 15.7-2 Deck Unit Schedule

DECK UNIT SCHEDULE

TYPE OF DECK UNIT	MASS (tonnes approx.)	No OFF	TOTAL MASS (tonnes)
19A	18.3	10	183
19B	20.1	1	20.1
19C	23.2	1	23.2

Transverse Stressing Unit Schedule

A schedule for the transverse stressing units is to be shown in a table on the drawings.

The schedule shows the length of stressing bar, the combined mass of the stressing bar and its anchorages, the number of stressing units, and the total mass of stressing units. Refer Figure 15.7-3 *Transverse Stressing Unit Schedule*.

When calculating the length of transverse stressing bars, perform the base calculation, round up to the nearest 50 mm then add an additional 50 mm to the length. The mass of 29 mm diameter transverse stressing bar is calculated at 5.44 kg/m. The mass of one 150 x 130 x 40 mm thick anchor plate is 6 kg.

Figure 15.7-3 Transverse Stressing Unit Schedule

TRANSVERSE STRESSING UNIT SCHEDULE

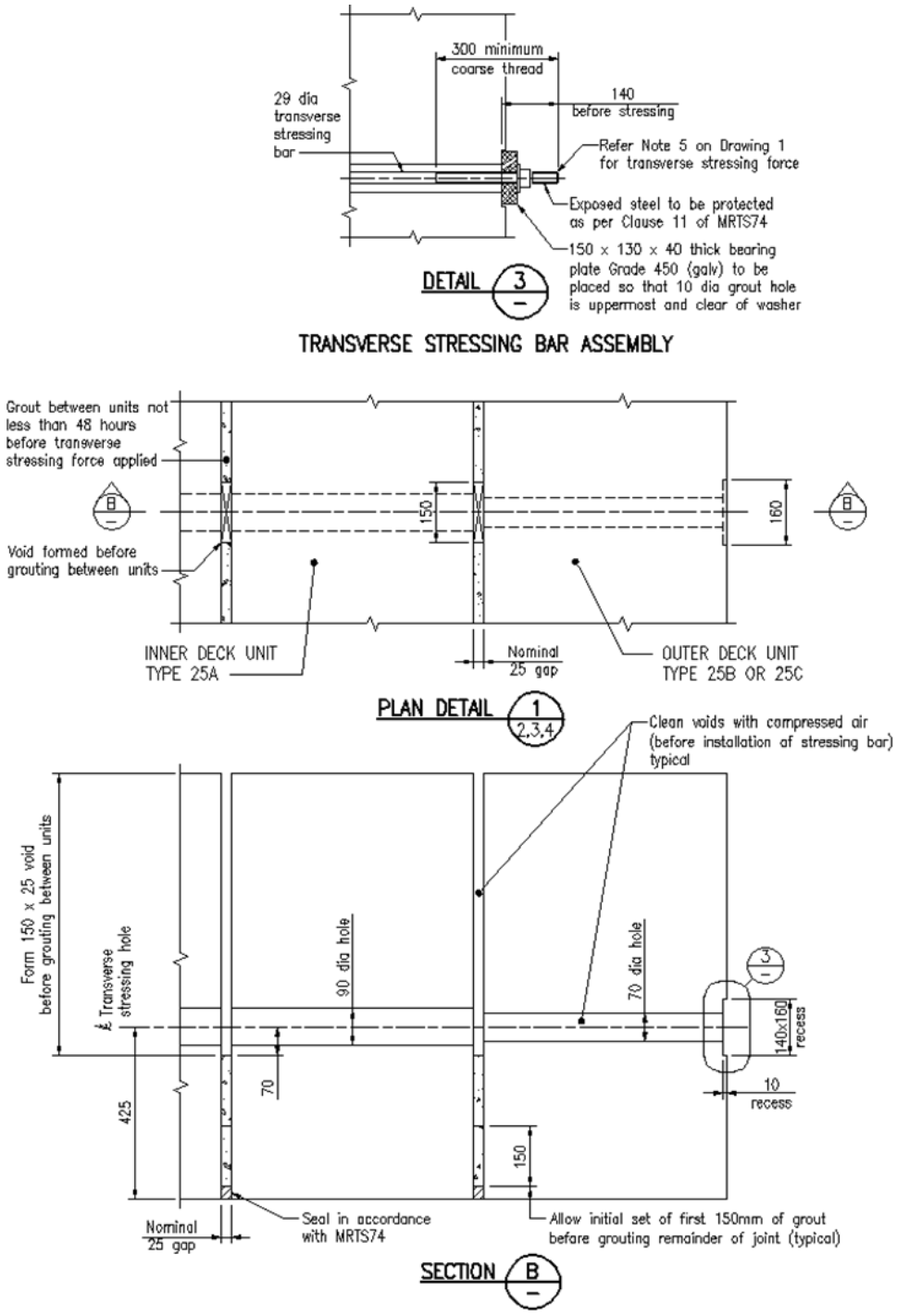
LENGTH (m)	MASS # (tonnes)	No OFF	TOTAL MASS # (tonnes)
13.250m	0.084	44	3.696

including transverse stressing anchorages

Transverse Stressing Assembly

Transverse stressing bars are to AS/NZS 4672.2 and AS/NZS 4672.1-bar-29-1030-P (with 300 mm minimum coarse tread at each end). Anchorages consist of a bearing plate 150 x 140 x 40 mm thick supplied with a nut and flat washer. These components are to be hot dip galvanised. Refer Figure 15.7-4 *Square Transverse Stressing Assembly*. On occasions it may be necessary, for tolerance, to have a larger hole than the normal 70 mm diameter in the outer deck units, for example on a bridge widening. The designer is to check the bending of the anchor plate into the hole to ensure the plate is of sufficient thickness.

Figure 15.7-4 Square Transverse Stressing Assembly



Bridge Traffic Barrier Post Locations

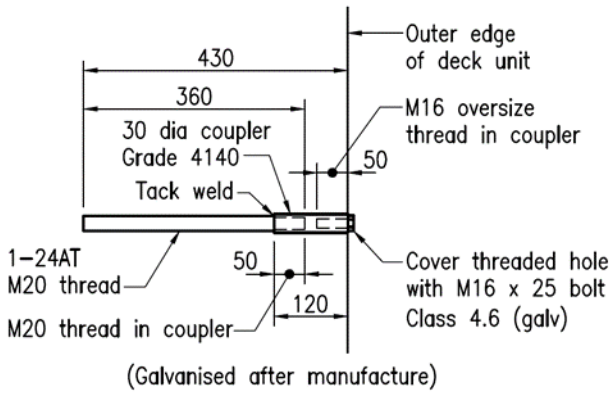
Refer to Standard Drawing 2510 – *Bridge barriers (Regular performance)* for post spacing details. The drafter is to check for any clashes between kerb starter bars and post anchorages. The location of kerb starter bars may need to be altered to avoid clashes.

Formwork and Services Anchor

All outer deck units have cast in formwork anchors. Refer Figure 15.7-5 *Formwork and Service Anchor*. These anchors may also be used for future services attachment as follows:

- Formwork anchors: One row of anchors, 110 mm down from top of unit
- Service attachment anchors: Generally one row, 110 mm down from top of unit, but two rows may be needed (one at the top and one near the bottom of the deck unit between strands) dependent on size of services.
- Avoid placing anchors directly over or near transverse stressing units so as to prevent potential clashes of formwork and services supports with transverse stressing units.

Figure 15.7-5 Formwork and Service Anchor – Typical details



15.8 Holding Down Bolt Holes

A holding down hole/slotted hole is cast into both ends of a deck unit. A holding down bolt/threaded rod/dowel bar is grouted into this hole to attach the deck unit to the headstock it is supported by. If the hole is for a holding down bolt/threaded rod, a recess is cast above the hole.

Dowel bars may only be used for bridges seated on cement mortar, where the soffit of the bridge super-structure is above a 2000 ARI flood.

Holding Down Bolt Hole Setting Out for Fixed and Continuous Joints

As detailed on the standard drawings when the deck unit is square, a 70 mm diameter holding down bolt hole is located 200 mm from each end of the deck unit. In order to maintain required cover from the holding down bolt recess to the second end grid, this distance increases as the skew increases.

Holding Down Bolt Hole Setting Out Expansion Joints

If the end of a deck unit sits on an expansion elastomeric bearing, the hole is slotted and the recess above it is rectangular. When the deck unit is square, a slotted holding down bolt hole is located 240 mm from each end of the deck unit. In order to maintain requred cover from the holding down bolt recess to the second end grid, this distance increases as the skew increases.

15.9 Skewed Deck Units

Void Lengths

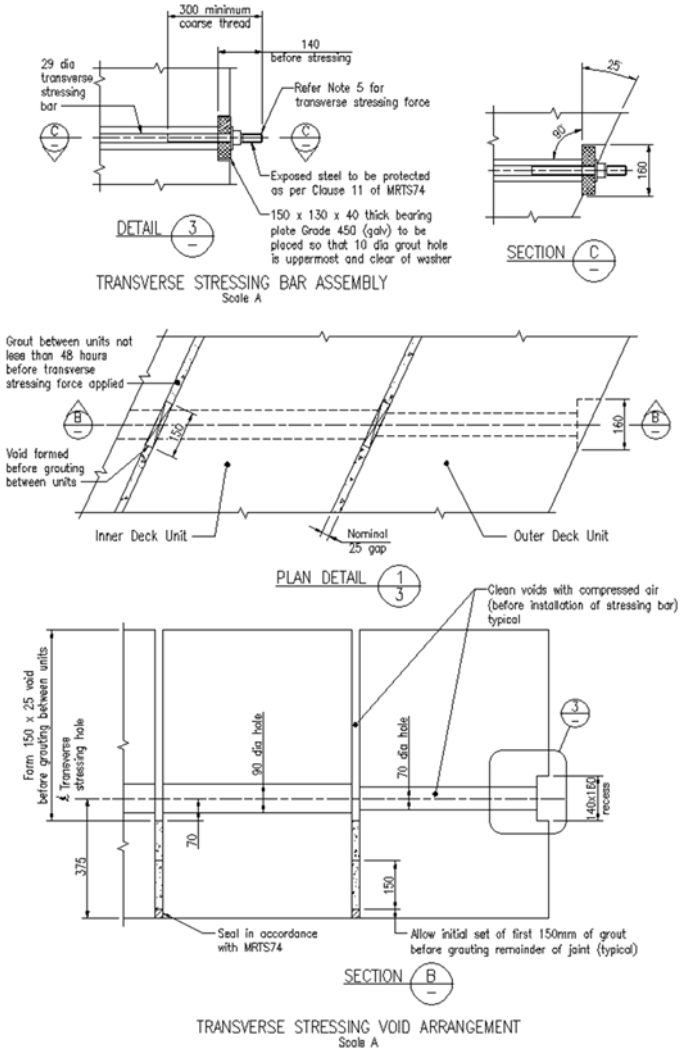
Void lengths in skewed deck units shall be reduced to maintain 50 mm minimum clearance to scuppers, reinforcement and transverse stressing holes. This will necessitate a change in the mass of units. The density of concrete used to calculate the mass is:

- 2.6 t/m^3 – inner deck units
- 2.7 t/m^3 – outer deck units
- 2.7 t/m^3 – deck units on RC deck bridges.

Transverse Stressing Assembly

On transversely stressed deck unit bridges, the recesses in which the bearing plates sit are formed to match the skew. Refer Figure 15.9-1 *Skewed Transverse Stressing Assembly*.

Figure 15.9-1 Skewed Transverse Stressing Assembly



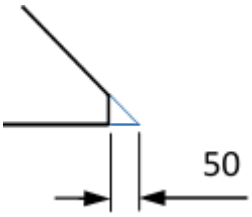
Shear Keys

On transversely stressed deck unit bridges skewed >30°, shear keys shall be provided. Generally, shear keys shall be 225 mm wide, 12 mm deep, and extend from the top of the deck units down to a level 75 mm above the bottom of the deck unit. Shear keys are to be spaced at approximately 1 m centres along the length of deck units. Shear key details are to be verified as part of the design and certification process.

Chamfers

On bridges skewed >30°, the acute angle corners of deck units are to be chamfered. Refer Figure 15.9-2 *Chamfered Corners*.

Figure 15.9-2 Chamfered Corners



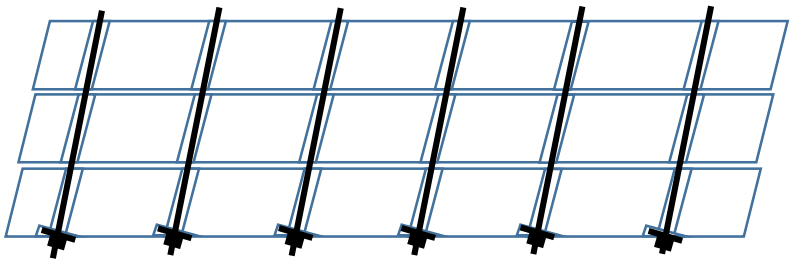
15.10 Expansion Joints

At piers or abutments where the deck units have expansion bearings, (or expansion/fixed at piers), an expansion joint is required to accommodate movements and seal the deck units on adjacent spans. Refer Chapter 18 – *Expansion Joints and Miscellaneous Details* and Chapter 17 – *Cast Insitu Kerbs and Decks, Appendix A Deck Design Sketches.*

15.11 Bridges around Curves

When deck unit bridges are built around a horizontal curve, the combination of skew, radius of curve, and span length, contributes to the ends of the deck units assuming a ‘saw tooth’ profile – shown diagrammatically in Figure 15.11-1.

Figure 15.11-1 Sawtooth Effect



Under this saw tooth effect, the resultant angle of skew on common points of the deck units, for example the stressing bar holes, varies from the nominated skew of the deck.

The size of stressing bar holes in inner deck units only may be altered where necessary to accommodate this variation as follows:

- ≥0.5° variation, use standard 70 mm diameter hole
- 0.5 to 2° variation, use 140 x 70 mm diameter slotted hole

- >2° variation, a RC deck design shall be used, eliminating the need for transverse stressing bars entirely

15.12 RC Deck on Deck Units

The department's standard deck units cannot be used in conjunction with a RC deck. Deck unit bridges with a RC deck will need project specific deck unit design, however, the layout of the drawings shall be similar to the standard deck unit drawings. Generally these deck units are not as deep as the corresponding standard deck units.

While the ligatures in standard deck units are placed normal to the edge of the units, they may be skewed for RC deck on deck unit bridges for skews ≤ 30°. The deck reinforcement is also skewed so that the starter bars from the deck units and the deck reinforcement are in the same plane. Refer Figure 15.12-1 *Reinforcement for Skews ≤ 30°*.

For skews > 30° the starter bars and deck reinforcement are to be placed normal to the control line. Refer Figure 15.12-2 *Reinforcement for Skews > 30°*.

Figure 15.12-1 Reinforcement for Skews ≤30°

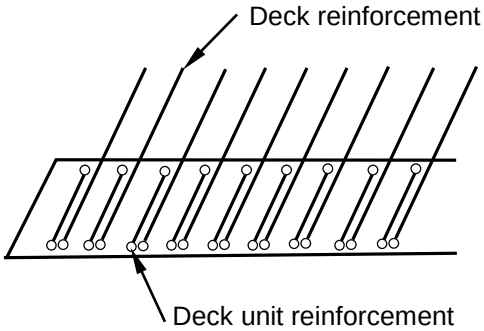
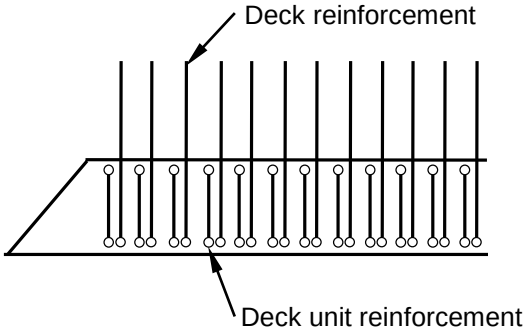


Figure 15.12-2 Reinforcement for Skews >30°



The starter bars that protrude into the deck can be one of two shapes. When there are only small gaps between deck units (up to 50 mm), the bars can be vertical as shown in Figure 15.12-3 *Close Gaps between Deck Units*.

Where the deck units are spaced more widely apart (over 50 mm), formwork (FC sheet) is placed on top of the deck unit. In this case LL shape bars are used. These bars are angled in, and tied to the top strands in the unit (which are also moved inwards). This provides a larger area on top of the unit for the FC sheet to be placed. Refer Figure 15.12-4 *Large Gaps between Deck Units* and Chapter 17 – *Cast Insitu Kerbs and Decks, Appendix A Deck Design Sketches – Sheet 3*.

Figure 15.12-3 Close Gaps between Deck Units

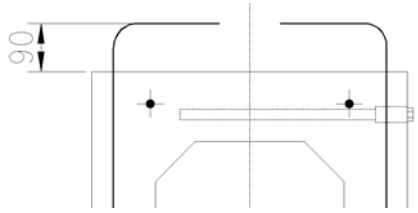
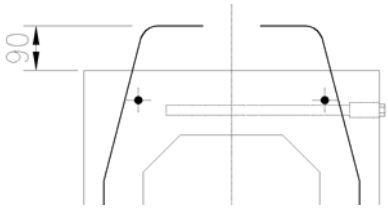


Figure 15.12-4 Large Gaps between Deck Units



15.13 Stage Construction and Bridge Widening

When the deck is constructed in stages, or the bridge is being widened, discontinuous couplers are used to couple the transverse stressing bar extension to the original bar. For additional details refer Chapter 8 – *Bridge Widening, 8.6 PSC Deck Unit Issues*.

The full requirements for recesses, stressing bar, anchorages and couplers are to be detailed on the deck unit drawings. The length of stressing bar shall be based on positioning the coupler adjacent to the gap in the deck units. Refer Figure 15.13-1 *Example Joint* and Figure 15.13-2 *Recess for Stage Construction* for typical details.

Figure 15.13-1 Example Joint

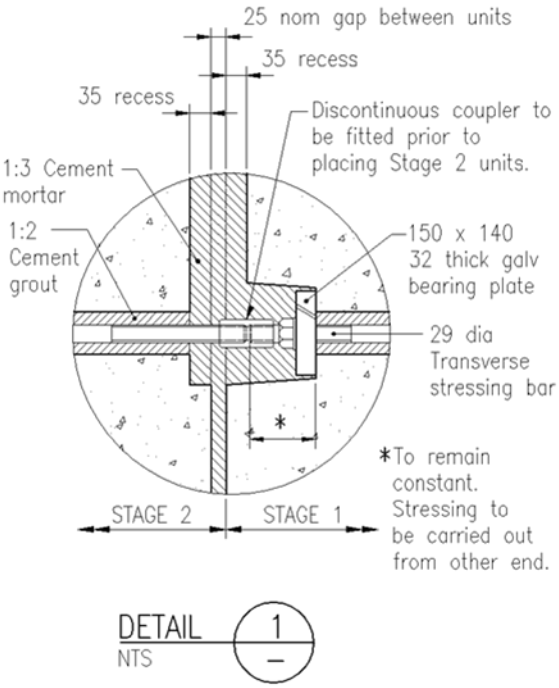
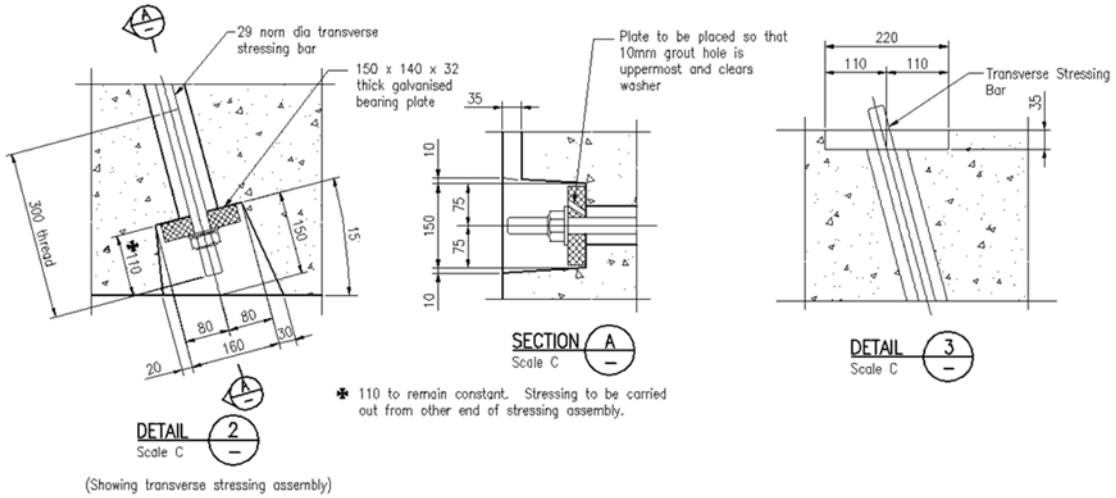


Figure 15.13-2 Recess for Stage Construction



15.14 Deck Drainage

The need for scuppers shall be determined by a hydraulic analysis.

Cast Insitu Kerbs

On superelevated deck unit bridges with cast insitu kerbs or concrete barriers, the unit on the high side is to be detailed without scuppers.

Scuppers on Overpass Bridges

Water shall not discharge directly onto the roadway below. Instead, the water shall be collected with an approved drainage system and channelled off the bridge. For additional information refer Chapter 17 – *Cast Insitu Kerbs and Decks, 17.12 Deck Drainage and Scuppers*.