

Drafting and Design Presentation Standards Manual (DDPSM)

Volume 3: Structural Drafting Standards
Chapter 2 - Standard of Presentation

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1 General

The presentation of all the content on the drawings shall be consistent across the set without change. The preparation of drawings shall be completed to the standards of detailing, accuracy, and completeness set out in this volume.

As stated in DCBoS, a thorough check of all the drawings shall be carried out to ensure completeness, accuracy, and unambiguity of all the information necessary to enable construction of the works.

2 TMR AutoCAD Customisation

The *TMR AutoCAD Customisation* contains tools and objects that enable the production of drawings in AutoCAD that follow the standards documented in this volume.

Scale bars, Blocks, and Styles can be accessed from the TMR Tools palette that is in the bundle. The Bridge A1 drawing sheet within the Plan Sheets of *TMR AutoCAD Customisation* can work as a template and contains TMR Dimension Style and Leader Style, and TMR layers.

Full details are provided on the following website:

[Transport and Main Roads AutoCAD customisation \(Department of Transport and Main Roads\) \(tmr.qld.gov.au\)](https://www.tmr.qld.gov.au).

3 Title block for structural engineering drawings

Table 2.4.3.1 of DDPSM *Volume 1, Chapter 2* lists the range of the departmental drawing sheets to be used for which engineering discipline and describes the typical usage for each sheet.

The sheet to be used for structural engineering drawings is MRB_Detail and is available under the Bridge A1 tab of Plan Sheets within *TMR AutoCAD Customisation*.

The primary reason for a dedicated structural engineering sheet is to capture RPEQ verification, review and certification, and the Design Criteria on each drawing in a set.

The following example (Figure 3) of the MRB_Detail drawing sheet is as per *TMR AutoCAD Customisation* at the time of publishing and may differ from example drawings within the volume that use earlier versions, and from later versions obtained via *TMR AutoCAD Customisation*.

Features within the title block are discussed below.

3.1 Bridge design criteria information

The MRB_Detail title block is prepopulated with bridge-specific design criteria requirements. The Bridge design criteria information box may be customised to suit the design criteria of other structures. Irrelevant criteria categories may be also marked as N/A (Not applicable).

3.2 SID number

Structures, as defined under SIM Part 1 and in the road corridor are assigned a Structure ID (SID) in the department's Bridge Inventory System (BIS). In the MRB_Detail title block, the SID box is located prominently in the bottom right-hand corner. This facilitates future referencing and location of archived design drawings.

For structures other than bridges that each have their own SID, refer to Section 2.3 of DDPSM Volume 3, Chapter 5 drawings for guidance on submitting them together in one drawing package.

3.3 Drawing number

Departmental drawing numbers are supplied by the department's Plan Room and are to be requested through the Transport and Main Roads Regional Administrator.

3.4 Drawing series number

Structural drawings have a secondary numbering system known as drawing series numbers, below the drawing number on the title block, and also within the drawing index on the cover sheet.

The purpose of a drawing series number (DSN) is to organise drawings in sub-sets in sequential order, each drawing with a unique DSN, before the allocation of Transport and Main Roads Plan Room drawing numbers occurs. For more information, refer to Section 2.2 of DDPSM Volume 1, Chapter 2 Appendix 2E.

Below the series number is usually the count for the full set, expressed as, for example, BR01 Drgs 7 of 34, that is, the 7th drawing of total 34 BR01 drawings.

Explanation of a typical DSN for a bridge is as follows:

BR01-GA-01 of 02

Where:

- **BR01** is bridge number 1 (there may be more than one bridge in the contract)
- **GA-01** is General Arrangement – Sheet 1 of 2

The following tables are based on Table E2.2(a) of DDPSM Volume 1, Chapter 2, and demonstrate the typical series numbers found on departmental structural drawings and sub-set of drawings. Table 3.4(a) lists those used for bridge drawings, and Table 3.4(b) for other structures drawings.

Table 3.4(a) – Typical Series Numbers for Bridge drawings

Structure Type Code	Series Code for drawing sub-set	Description
BR for bridges	LP	Locality Plan
	DI	Drawing Index
	GN	General Notes
	GA	General Arrangement Layouts / Details
	CS	Construction Sequencing / Temporary Works Layout / Details
	GE	Geotechnical Layout and Details
	PI	Piling Layout and Details
	AB	Abutment Layout / Details
	PR	Pier Layout / Details
	BE	Bridge Bearings Layout / Details
	TM	Bridge Tower Mast Layout / Details
	DU	Deck Units Layout / Details
	GI	Girders Layout / Details
	BG	Box Girder Layout / Detail
	SG	Steel Girder Layout / Details
	DK	Bridge Deck and Barrier Layout / Details
	EJ	Expansion Joint and Cover Plate Layout / Details
	PD	Precast Deck Layout / Details
	CA	Bridge Cable Layout / Details
	BP	Bridge Barrier Panel Details
	TR	Traffic Rail Layout / Details
	BA	Balustrade Layout / Details
	RS	Relieving Slab Details
SC	Safety Screens / Anti-Throw Screens	
NB	Noise Barrier Details	

Structure Type Code	Series Code for drawing sub-set	Description
	RL	Road Lighting Details
	DD	Drainage Details
	EP	Embankment Protection Layout / Details
	IM	Inspection and Maintenance Layout / Details
	MD	Miscellaneous Details

Table 3.4(b) - Typical Series Numbers for Other structures drawings

Structure Type Code	Series Code for drawing sub-set	Description
CU for culverts or DD for other drainage structures	LP	Locality Plan
	DI	Drawing Index
	GN	General Notes
	GA	General Arrangement Layouts / Details
	CS	Construction Sequencing / Temporary Works Layout / Details
	CD	Concrete Layout / Details
	RD	Reinforcement Details
	MD	Miscellaneous Details
RW for retaining walls	LP	Locality Plan
	DI	Drawing Index
	GN	General Notes
	GA	General Arrangement Layouts / Details
	CS	Construction Sequencing / Temporary Works Layout / Details
	GR	Ground Reinforcement Details
	PI	Piling Layout and Details
	CD	Concrete Layout / Details
	RD	Reinforcement Details
	MD	Miscellaneous Details

Structure Type Code	Series Code for drawing sub-set	Description
SF for sign support structures	LP	Locality Plan
	DI	Drawing Index
	GN	General Notes
	GA	General Arrangement Layouts / Details
	CS	Construction Sequencing / Temporary Works Layout / Details
	GR	Ground Reinforcement Details
	PI	Piling Layout and Details
	PF	Pad / Spread Footing Layout / Details
	CD	Concrete Layout / Details
	RD	Reinforcement Layout / Details
	SD	Structural / Steel Details
	MD	Miscellaneous Details
NB for noise barriers	LP	Locality Plan
	DI	Drawing Index
	GN	General Notes
	GA	General Arrangement Layouts / Details
	PI	Piling Layout and Details
	PF	Pad / Spread Footing Layout / Details
	CD	Concrete Layout / Details
	RD	Reinforcement Layout / Details
	SD	Structural / Steel Details
	MD	Miscellaneous Details

3.5 Revisions and Drawing Index

Revision letter A is always the original 'Issue for Construction' (IFC) issue, then B for the first revision after original IFC and so on.

Refer to DDPSM Volume 1, Chapter 1 and Chapter 2 for further details on the use of revision letters and revision clouds on project drawings.

Revision letters shall be included in the Drawing Index for the original IFC drawings and any subsequent reissue of the IFC drawings, as well as for As Constructed drawings. The date of the revision may be omitted.

The Drawing Index shall be updated and reissued with the current revision letter of the latest revision of each drawing listed; this applies to IFC and As Constructed drawings.

The Drawing Index shall have columns for drawing number, revision letter, date of revision, drawing series number, and drawing description. The following figure is an example with revision clouds and label.

Figure 3.5 – Example of Drawing Index

DRAWING INDEX

Drawing Number	Revision	Date	Series Number	Drawing Description
930276	B	11/23	BR-DI-01 of 01	DRAWING INDEX, LOCALITY MAP AND SCHEME APPROVAL
930277	B	11/23	BR-GN-01 of 01	GENERAL NOTES
930278	B	11/23	BR-GA-01 of 04	GENERAL ARRANGEMENT – SHEET 1
930279	B	11/23	BR-GA-02 of 04	GENERAL ARRANGEMENT – SHEET 2
930280	B	11/23	BR-FD-01 of 02	FABRICATION DETAILS – SHEET 1
938685	A	11/23	BR-GA-03 of 04	GENERAL ARRANGEMENT – SHEET 3
938686	A	11/23	BR-GA-04 of 04	GENERAL ARRANGEMENT – SHEET 4
938687	A	11/23	BR-FD-02 of 02	FABRICATION DETAILS – SHEET 2



3.6 Survey data and associated or auxiliary documentation

A table to list documentation such as survey data, associated departmental jobs and auxiliary drawing numbers, that was previously listed within older versions of the title block, is to be included on either the Cover sheet, General Notes drawing, or the first sheet of General Arrangement drawings set.

3.7 CAD files

The bottom left of the title block contains an automatically-generated string of metadata. This data contains the file path and file name to assist with location of the electronic drawing file related to the drawing.

An example is G:/ET Structures/05 P&D/Projects/Mt Crosby/Autocad/M1401Kerbs.dwg

4 Text

Text characteristics shall be used on the drawings without change.

Text shall be to the requirements stated in Section 2.3.3 of DDPSM Volume 1, Chapter 2.

The convention is for sentence case lettering (Upper and lower) to be used for drawing text, notes, and dimensions.

The heights of text on A1 size structural engineering drawings are listed in Table 4; this follows *TMR AutoCAD Customisation* for pen thickness and specifies typical application on the drawings. The AutoCAD layer names may be changed.

Table 4 - Text on structural drawings

Case	Thickness of pen	Height	Typical application	AutoCAD layer
Upper and lower	0.35 mm	3.5 mm	Drawing text / Notes / Dimensions	MR_TXT_035
Upper and lower	0.5 mm	4.0 mm	Heights / No OFF / Secondary wording in Titles	MR_TXT_050
UPPER	0.5 mm	4.0 mm	Sub-Titles / Bridge Control	MR_TXT_050
UPPER	0.7 mm	5.0 mm	Titles	MR_TXT_070

5 Notes for structural engineering drawings

Notation on drawings shall be clear and concise with regard to information and instructions and specific to the structure being detailed in the drawings. Where a set of drawings for a structure is within a package for multiple structures, each structure shall have its own set of Notes, and the presentation of all notations shall be consistent across all sets of drawings within a package without change.

Notes shall reference the appropriate departmental, Australian and/or international standards.

Notes shall be listed in each category in order of importance and follow a logical order, with notes critical to the element listed first.

It is not necessary to repeat standard specification clauses within Notes. This is to avoid inadvertent contradictions or errors, or out of date information.

Notes shall be directed to the contractor undertaking the works and written in such a way so as to avoid ambiguity of responsibility.

The Notes specific to a drawing sub-set that may be given to a sub-Contractor shall have those Notes specific to that element or activity shown on the sub-set of drawings, so that the sub-Contractor has a full appreciation of the contract requirements.

Construction procedure or sequence notes may be required for an element or activity, for example, future jacking or rehabilitation activities. These Notes shall be positioned as near as possible to the relevant view.

The remainder of the Notes specific to the structure and general in nature may be compiled together into a sub-set of dedicated General Notes drawings at the front of the drawings. This compilation starts with General Notes, and then materials and construction notes arranged in a logical order.

If using a sub-set of dedicated General Notes, they shall follow immediately after the Cover Sheet and Drawing Index (refer to Chapter 4 and Chapter 5 of this volume).

Traditionally, Notes were shown on the element drawing or the first drawing in each sub-set, and this is still the recommended practice.

Section 2.9 of Austroads *Guide to Bridge Technology – Part 5: Structural Drafting* also provides good guidance.

The sample notes in Chapter 5 in the previous volume have not been replicated in this volume.

Example General Notes drawings from recent projects are included in this volume.

5.1 Abbreviations, contractions and acronyms

Refer to Glossary of Terms in Chapter 1 of this volume, and to Section 2.3.3.6 of DDPSM Volume 1, Chapter 2.

Abbreviations, contractions and acronyms are all described as Abbreviations when listed in project drawings.

Abbreviations for metric units are always styled as shown in Table 2.3.3.8(b) of DDPSM Volume 1, Chapter 2.

Contractions and acronyms are only recommended to be used when space is limited. There is no need for a full stop in any abbreviation.

6 Projection

In accordance with AS 1100.101, third angle projection is the projection method to be used. Each view is placed so that it represents the side of the object near to it in the adjacent view. The direction that the view is taken is to be clearly indicated by section arrows.










7 Linework




All linework shall be in accordance with AS 1100.101.

The thicknesses of lines are to be used on the drawings without change.

Table 7 follows *TMR AutoCAD Customisation* and is a useful map of TMR's line types, layer name, line thickness, and AutoCAD colours, and their typical application on the drawings. The layer names and colours are as provided and may be changed.

Table 7 – Line styles for structural drawings

Line thickness and style	Typical application	AutoCAD layer
Continuous lines		
0.18 mm thick 0.25 mm thick 	Hatching 0.18 or 0.25 mm. Dimension lines 0.25 mm. Break lines 0.25 mm.	MR_CON_HAT MR_DIM MR_CON_025
0.35 mm thick 	Outlines for reinforcement views, internal linework.	MR_CON_035
0.5 mm thick 	Outlines of views excluding reinforcement views.	MR_CON_050
0.7 mm thick 	Reinforcement.	MR_CON_070
0.25 mm thick, dark grey colour 	Major contour lines.	MR_CONTOUR_MAJOR (colour 250)
Dashed lines		
0.25 mm thick 0.35 mm thick 	Hidden detail.	MR_DSH_025 MR_DSH_035
0.5 mm thick 0.7 mm thick 	Strip filters behind abutments. Reinforcement in far face.	MR_DSH_050 MR_DSH_070
0.18 mm thick, dark grey colour 	Minor contour lines.	MR_CONTOUR_MINOR (colour 250)
Double chain lines		
0.25 mm thick 0.35 mm thick 	Existing structures or features.	MR_DCH_025 MR_DCH_035

Line thickness and style	Typical application	AutoCAD layer
Chain lines		
0.25 mm thick 	Centre lines.	MR_CHN_025
0.7 mm thick 	Road and Bridge Controls.	MR_CHN_070
Construction joint lines		
0.35 mm thick 	Construction joints.	MRB_CJ_035

8 Structure element identification and nomenclature

Transport and Main Roads has developed a detailed set of component codes for bridge elements to ensure consistency in documentation and modelling. These codes are designed to work in conjunction with the department's *Building Information Modelling (BIM) for Bridges* manual and *Structures Inspection Manual (SIM)*.

It is important to use element marks and types when noting an element in a drawing or schedule, especially when there are multiple similar elements. These marks should include the relevant component codes to clearly distinguish between different element types.

A component code is a short, often standardised abbreviation or label used to identify a specific part or element of a larger system or structure. It provides a quick and easy way to reference components without using long descriptions. The component codes for bridges are outlined in Table 8, along with an example element type or mark.

Where drawing marks include both alphanumeric and numerical codes, they should be separated by a hyphen ("-") between the component code and the element type, for example, "BG-1A". Detailed guidance on marking specific elements is provided later in this volume.

Contracts requiring a BIM deliverable shall ensure that all objects include a unique identifier in their metadata, in accordance with the department's *BIM for Bridges* manual.

Table 8 - Typical bridge element identification and nomenclature

Group	Group code	Component	Component code	Example of Type or Mark
Abutments	A	Abutment protections	AP	-
		Blade walls	BW	BW1, BW-1A
		Deflection walls	DW	DW1, DW-1A
		Headstocks	HS	-
		Relieving slabs	RS	-
		Retaining walls	RW	RW01
		Wing walls	WW	W1, WW1
Piers	P	Blade walls	BW	BW1, BW-1A
		Deflection walls	DW	DW1, DW-1A
		Headstocks	HS	-
		Pier columns	CO	CO-AA-01, CO-P1-01
		Tower arms or cross supports	TA	TA1
		Tower masts	TM	TM-1A
Foundations	F	Cast in place piles	CP	CP-AA-01, CP-P1-01
		Driven tubular steel piles	SP	SP-AA-01, SP-P1-01
		Pad (spread) footings	PF	PF-AA-01, PF-P1-01
		Pile caps	PC	PC-AA-01, PC-P1-01
		Precast piles	PP	PP-AA-01, PP-P1-01
		Waler beams or pile bracing	WB	WB1
Bridge traffic barriers	T	Concrete parapet types	TC	TC1, TC-1A
		Guard rails	GR	GR-1, GR-1A
		Noise barriers	NB	NB01
		Noise screens	NS	NS-1A
		Pedestrian and shared balustrades	BA	BA01, BA-1A

Group	Group code	Component	Component code	Example of Type or Mark
		Privacy screens	PS	PS-1A
		Safety rails	SR	SR1, SR-1A
		Safety screens or anti throw screens	SS	SS1, SS-1A
		Screen posts	SP	SP1, SP-1A
		Steel post and rail types	TR	TR1, TR-1A
Bridge bearings	B	Bearing pedestals	PE	PE-AA-01, PE-P1-01
		Elastomeric bearings	BE	BE-AA-01, BE-P1-01
		Pot bearings	BP	BP-AA-01, BP-P1-01
		Restraint angles	RA	RA-AA-01, RA-P1-01
		Restraint blocks	RB	RB-AA-01, RB-P1-01
		Restraint plates	RP	RP-AA-01, RP-P1-01
		Rocker bearings	BR	BR-AA-01, BR-P1-01
		Spherical bearings	BS	BS-AA-01, BS-P1-01
		Thrust bearings	BT	BT-AA-01, BT-P1-01
		Mortar pads	MP	-
		Drip pan or plate	PL	PL-1A
Decks	D	Anchorage	AN	AN1, AN-1A
		Cast insitu decks	DK	-
		Cast insitu kerbs	KE	-
		Cross girders	XG	XG1, XG-1A
		Deck wearing surfaces	AC	-
		Fascia panels	FP	FP1, FP-1A
		Holding down bolts	HB	-

Group	Group code	Component	Component code	Example of Type or Mark
		Shared paths and footways	FW	-
Girders	G	Arch girder	AG	AG-1A, AG-A
		Box girder	BG	BG-1A, BG-A
		Concrete girders	CG	CG-A
		Deck units	DU	DU-A
		Diaphragms	DI	DI-A
		Fibre composite girders	FC	FC-A
		Steel girders	SG	SG-A
		Timber girders	TG	TG-1A, TG-A
		Transverse bars	TB	TB1
		Winged planks	WP	WP-A
Steel superstructure	S	Secondary members		
		Cross beams	CB	CB1
		Outriggers	OR	OR1
		Prefabricated steel deck modules	DM	DM-1A
		Support beams	SB	SB1
		Transoms	TR	TR1
		Bracing members		
		Bottom bracing	BB	BB1
		Diagonal bracing	DB	DB1
		External / Cross bracing	XB	XB1
		K-Bracing	KB	KB1
		Plan bracing	PB	PB1
		Tension / Tie bracing	TB	TB1
		Plates		
		Diaphragm plates	DP	DP1
		End bearing plates	EB	EB1
		End cap plates	CP	CP1
		Longitudinal stiffener plates	LS	LS1
		Transverse stiffener plates	TS	TS1

Group	Group code	Component	Component code	Example of Type or Mark
Cables and cable stays	C	Cable stays		
		Cable – Back stays	BS	BS-1A, BS-2A
		Cable – Main stays	MS	MS-1A, BS-2A
		Cable – Temporary stays	TS	TS-1A, TS-2A
		Tie down anchorages	TD	TD1, TD-1A
		Suspension cables		
		Anchor cables	AC	AC-1A, AC-2A
		Hanger cables	HC	HC-1A, HC-2A
		Lateral cables	LC	LC-1A, LC-2A
		Main cables	MC	MC-1A, MC-2A
		Suspension cables	SC	SC-1A, SC-2A
Miscellaneous details	M	Anchorage	AN	AN1, AN-1A
		Cover plates	CV	CV1, CV-1A
		Drainage pipes	DP	-
		Drainage scuppers	DS	-
		Expansion joints	EJ	-
		Joints	JT	-
		Lighting brackets	LB	LB-A
		PUP communication conduits	CC	-
		PUP electrical conduits	CE	-

NOTE: The component codes are always to be referenced directly from the latest version of the department's *BIM for Bridges* manual.

9 Dimensions

Each dimension necessary for the complete definition of a particular element shall be clearly shown on the drawing and shall be shown once only.

Dimension and leader line arrows are to be 3.5 mm on A1 size drawing, filled in type.

Dimension text height shall be 3.5 mm on A1 size drawing with recommended offset of 1.5 mm from the dimension line.

The dimensioning of any element shall be such that:

1. no dimension relating to that element is to be deduced from other dimensions
2. all dimensions necessary to construct the element shall be shown so that there is no need to scale off a drawing to determine a dimension
3. dimensions shown on drawings shall be in millimetres and shall be placed parallel and above its dimension line and be able to be read either from the bottom or the right-hand side of the drawing
4. a chain of dimensions shall be covered by an overall dimension except where dimensional tolerances are of critical importance, and
5. where practical, dimensions shall be placed centrally between the arrows denoting the limit for the dimension.

9.1 Order of accuracy for dimensions

Dimensions shall be calculated to an accuracy of 1 mm and may then be rounded off as shown:

- concrete – 1 mm
- reinforcing bar spacing – 5 mm, and
- steel plate – 1 mm.

9.2 Order of accuracy for heights and chainages

Heights shall be calculated to an accuracy of 1 mm.

Heights and chainages shall be shown in metres to 3 decimal places as shown below:

- designed surface heights – 0.001 metres
- chainages – 0.001 metres
- contours – 0.250 metres generally, – 0.100 metres where ground is extremely flat, and
- existing surface, flood, and existing water heights, as reported.

9.3 Dimension, projection and leader lines

Dimension lines shall not be shown as centrelines or as part of an elements outline.

Projection lines for dimensions shall extend from a point not less than 2 mm on A1 size drawing from the surface of the object and finish not less than 2 mm beyond the dimension line.

Leader lines, projection lines, centre lines and so on are to be kept clear of dimension text as much as possible, otherwise the clashing line is to be broken to provide an uninterrupted view of the dimension text.

Leader lines shall commence from either the beginning or end of a note with a short horizontal line (say, length 4 mm on A1 size drawing) before being angled to the point of reference.

The termination of the leader line shall be with an arrow to the outline of the element, or with a fully shaded dot (for example, 1.5 mm diameter on A1 size drawing) within the area being noted.

10 Scales

The scale chosen should allow the dimensions of a drawing element to be clear and legible and, where possible, without the need to stack information along the dimension line.

Scale bars used are shown in the title block of the drawing and are referenced by a letter.

Quoting the scale used as a ratio, such as 1:200 at A1, causes confusion and is to be avoided.

Scale bars as blocks are available in *TMR AutoCAD Customisation*.

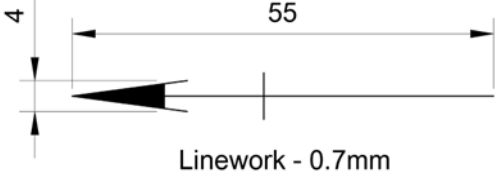
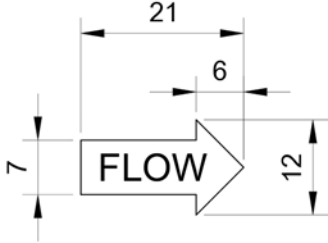
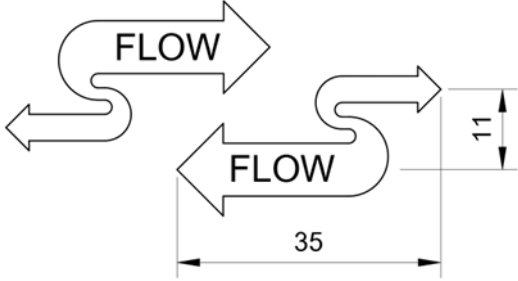
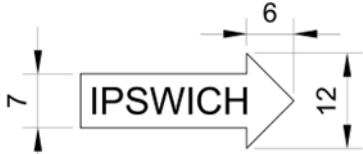
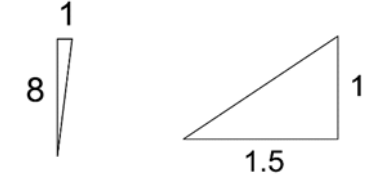
Recommended scales for views on structural drawings are shown in Table 1.2 of DDPSM Volume 3, Chapter 4.

Refer to Section 2.5 of Austroads *Guide to Bridge Technology – Part 5: Structural Drafting* for good guidance.

11 Typical standard symbols for structural engineering drawings

The following symbols are standard on departmental structural engineering drawings explained in the table below and are available as blocks in *TMR AutoCAD Customisation*, as mentioned previously.

Table 11 – Typical standard symbols

Symbol - description and use	Symbol - details
<p>North point arrow Shown on the Plan view of the General Arrangement drawing clear of all contours and notation.</p>	 <p>Linework - 0.7mm</p>
<p>Flow arrows Shown on the Plan view of the General Arrangement drawing to clearly show the direction of stream flow of the waterway. Flow arrows should be shown on specific views throughout the bridge drawings to confirm correct orientation.</p>	<p>One way flow</p>  <p>Text - 3.5mm, linework - 0.5mm</p> <p>Tidal flow</p>  <p>Text - 3.5mm, linework - 0.5mm</p>
<p>Road direction arrows Shown on the Plan view of the General Arrangement drawing to indicate the nearest town in each direction from the structure. Generally, the towns are those nominated in the road name of the title block.</p>	 <p>Text - 3.5mm, linework - 0.5mm</p>
<p>Rise over run A small right-angled triangle expressing the horizontal and vertical relationship, 1 on x, can be shown adjacent to the sloped face of a feature to indicate the angle.</p>	 <p>PILES EMBANKMENTS</p>

12 Welding

All weld details, dimensions, and tolerances shall be specified by a Structural Engineer.

Welding symbols on drawings shall conform to AS 1101.3 *Graphical symbols for general engineering, Part 3: Welding and non-destructive examination*.

13 Plan views and Elevations

Plan views shall be drawn as a view seen from a horizontal plane immediately above the element and with increasing chainage, laid out left to right on the sheet. Plan views showing the location of elements such as footings, piles, headstocks, decks, walls and so on, may also show reference markings, co-ordinates, and chainages.

Elevations shall be drawn as a view seen from a vertical plane immediately in front of the element and projected from that element's plan view. Hidden details are not required to be shown unless that part of the element is referenced by a height or a dimension.

14 Sections, Views, and Details

Views and Sections are usually drawn adjacent to the Plan view or Elevation that they are cut from, and, where necessary, may be placed at the most convenient location on the sheet. Where Views, Sections, or Details cannot be shown on the drawing of origin, they shall be cross-referenced in accordance with AS 1100.501 and the guidance set out below.

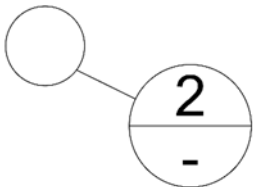

Marks and Titles as blocks are available in *TMR AutoCAD Customisation*.

The following guidance is good drafting practice and the department's preference:

- All Views and Elevations are drafted as if looking from Abutment A to Abutment B. For example, an Elevation of a pier on a bridge with a LHS High superelevation will show the LHS of the pier headstock high as if you are looking towards Abutment B. Similarly, all anchorage details and bridge and barrier elevations will be drafted as viewed from the RHS of the bridge as if Abutment B is to the right of the View, unless very specific limitations make this impractical to do so. The Elevation of Abutment B is the only general exception to this rule, as it is drawn looking at the front face of the abutment with Abutment B behind the viewer.
- Sections are a view taken from a defined cutting plane, at the same scale, or at a larger scale if doing so improves clarity.
- Sections should be hatched with the appropriate material pattern, and it is expected that a legend is shown on the drawing when several patterns are used. Sections showing reinforcement where hatching can obscure the line work should be left unhatched.

- Views are auxiliary Elevations looking from a position external to previously drawn Elevations and Plans, at the same scale.
- Details show a magnified view of a specific area of an element and the target area is typically enclosed by a circle or rounded square on the parent view, with a leader and detail mark attached, or that leader can run directly to the enlarged detail itself (refer to Figure 14).
- If staggered cutting planes are used, the change in direction of the staggered cutting plane is usually drawn as 0.7 mm thick lines.
- Transport and Main Roads uses letters to nominate Sections and Views.
- Transport and Main Roads uses numbers to nominate Details.
- Sections, Views, and Details, for each element, or for a drawing sub-set or series, are always in the same alphabetical and numerical sequence, for example Section A, View B, Detail 1. If the entire range of the alphabet is used, continue with AA, BB etc.
- Sections, Views, and Details shown on the parent drawing have a dash in the mark and title labelling, and if shown on another drawing, shall be cross-referenced using either the drawing number within the set, the drawing series number, or the department’s Plan Room drawing number. The method of cross-referencing shall be consistent across all sets of drawings within a package without change, and
- Section and detail marks and title examples are shown in Table 14 and Figure 14.

Table 14 – Examples of labelling for Sections, Views, and Details

Mark - description and use	Corresponding title - description and use
<p>Detail label Used to call up areas of a view which require enlarged or specific details. 12 mm diameter circle, Linework 0.5 mm pen, Text 4 mm high.</p> 	<p>Detail title Title of the corresponding detail called up. 18 mm diameter circle, Linework 0.5 mm pen, Text 4 mm high.</p> 

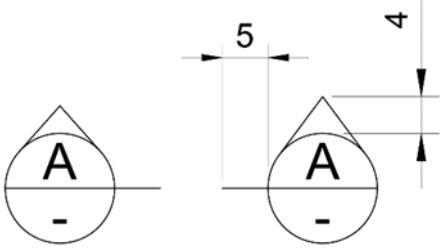
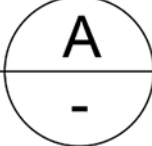
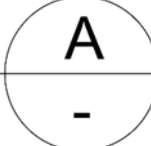
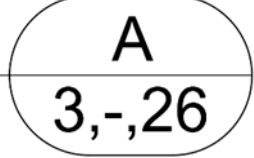
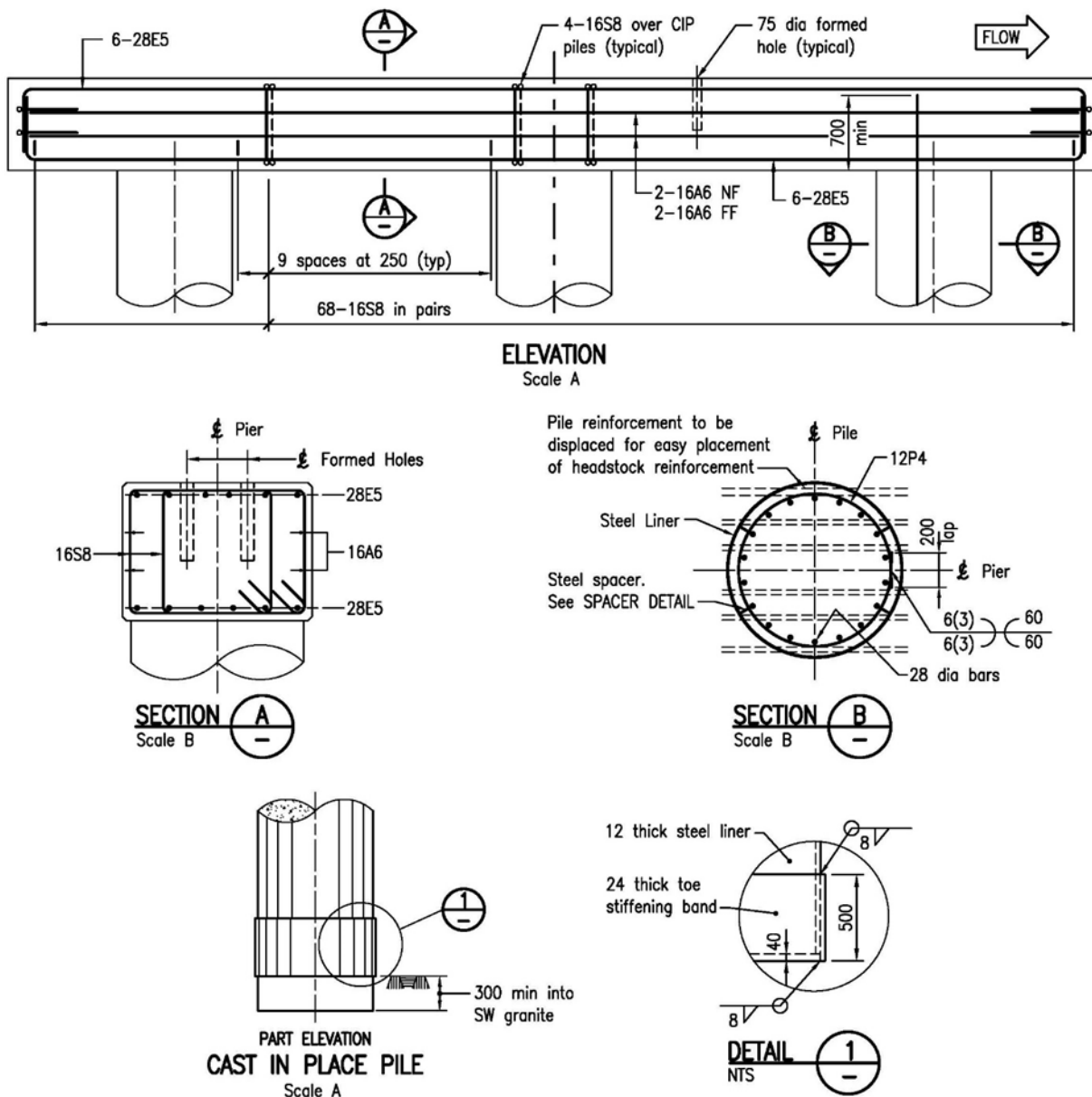
Mark - description and use	Corresponding title - description and use
<p>Section arrows</p> <p>Define the plane where a Section is cut or a View is orientated.</p> <p>Recommend a 12 mm diameter circle drawn in Linework 0.5 mm pen as suitable for the expected 4 mm high text.</p> 	<p>Section and View titles</p> <p>Title of the corresponding Section or View called up.</p> <p>Recommend a 18 mm diameter circle, and Linework 0.7 mm pen as suitable for the expected 5 mm high text.</p> <p>Where a Section or View is referenced on multiple drawings, the circle is to be stretched to include the additional drawing references as shown.</p> <div style="text-align: center;"> <p>SECTION </p> <p>Scale C</p> </div> <div style="text-align: center;"> <p>VIEW </p> <p>Scale C</p> </div> <div style="text-align: center;"> <p>SECTION </p> <p>Scale C</p> </div>

Figure 14 - Examples of Sections and Details



15 Concrete detailing

Concrete drawings shall be in accordance with AS 1100.501 and shall clearly show the dimensions and shape of each element, and the heights of concrete structures, with sufficient information for enable formwork to be built and erected, and quantities to be calculated.

Adequate cross-references are to be provided when any element is detailed elsewhere.

Section 3.4 of Austroads *Guide to Bridge Technology - Part 5: Structural Drafting* also provides good guidance.

Chamfers that are to be formed on the edges of components shall be noted on the drawings and should be drawn to scale (when they can be clearly seen in the details).

Formed holes, cast-in steel work, construction joints, and any blinding concrete are to be shown.

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

Cast-in items are to be cross-referenced to the drawings that provide sufficient details for their fabrication.

Holes shown on the drawings are referred to by how they are constructed - that is, formed, cored, or drilled - and to suit their application (refer to Section 3.4.2 of Austroads *Part 5* for further information).

16 Reinforcement detailing

Reinforcement detailing shall be in accordance with Standard Drawing 1043 *Reinforcing Steel – Standard Bar Shapes Typical Details and Notes (Drawing 1 of 4 to Drawing 4 of 4)* and Standard Drawing 1044 *Reinforcing Steel – Lap Lengths* and to the requirements of AS 1100.501.

Each bar shall be shown in at least 2 views on any drawing.

Good drafting practice includes verifying that all reinforcement can be easily placed, and that adequate concrete quality can be achieved. It is recommended, under the guidance of an RPEQ, to perform space-proofing in areas of congested reinforcement to identify potential constructability issues, such as restricted concrete flow or poor compaction. Any issues identified should be discussed with the design engineer.

Double linework reinforcement detailing may be useful when bar fitment in congested areas is being proven for fitment or detailed for congested and complicated reinforced zones.

Where design-specific laps are not specified by the designer, the lap lengths shall be in accordance with Standard Drawing 1044 *Reinforcing Steel – Lap Lengths*.

For top or horizontal reinforcement with more than 300 mm of concrete below the bars, standard lap and anchorage lengths shall be increased in accordance with Standard Drawing 1044 *Reinforcing Steel – Lap Lengths* and the laps shall be shown on the drawings.

Laps should be staggered and positioned away from points of maximum stress.

Maximum cutting length of steel reinforcing bars is usually 12 metres, allowing for practical handling during transport and placement.

Leg lengths should be limited to 1.4 metres because bending a bar with a long leg length may not be practicable. The designer should check with suppliers when leg length greater than 1.4 metres is required.

Approved safety caps shall be shown on protruding reinforcement without hooks.

For examples of laps, anchorage, spacing of reinforcement, and multilayered reinforcement, refer to Figure 16.1(a) and Figure 16.1(b), and for Sections, refer to Figure 14.

Bars intended to be bent on site shall be clearly shown both for the original shape as placed and for the final shape and position with an arrow indicating each bend path and including an explanation of placement activity where required (refer to Figure 16.1(c)).

The size and length of welds shall be as per the Standard Drawings (refer to Figure 16.1 (d)).

Good guidance for reinforcement detailing is also provided in:

- Concrete Institute of Australia *Reinforcement Detailing Handbook*, and
- Section 3.5 of Austroads *Guide to Bridge Technology – Part 5: Structural Drafting*.

16.1 Symbols and line work for reinforcement

Reinforcing bar shapes shown on TMR structural engineering drawings are as per Standard Drawing 1043 *Reinforcing Steel – Standard Bar Shapes Typical Details and Notes (Drawing 1 of 4 to Drawing 4 of 4)*, which lists the department's standard set of bar shapes. The standard bar shapes' letters on this drawing are reserved for those shapes.

Non-standard bar shapes not found in Standard Drawing 1043 *Reinforcing Steel – Standard Bar Shapes Typical Details and Notes (Drawing 1 of 4 to Drawing 4 of 4)* shall be fully detailed in the drawings. To avoid confusion, non-standard bar shapes are to use different letters to those already used in Standard Drawing 1043 *Reinforcing Steel – Standard Bar Shapes Typical Details and Notes (Drawing 1 of 4 to Drawing 4 of 4)*.

Reinforcing bars to be shown on the drawings should be drawn similar to the examples in Table 16.1.

Stirrups and ligatures shown in section are to be drawn to clearly show the shape of the bar.

Bars shown in section shall be drawn at an exaggerated diameter to provide legibility when printed at A3 size.

Similarly, bar separations at laps or of adjacent bars should be drawn sufficiently separated to provide a clear gap between bars when reduced to A3 size.

Bars may be drawn as double linework where complex or congested reinforcing requires proof of fitment. The minimum requirements for double lines shall be 0.25 mm thick line work spaced no closer than 0.5 mm, when plotted at A3 size, with thicker line work requiring greater spacing, so that the double lines drawn to represent the bars are visible as double lines. Bars drawn with 0.25 mm thick double linework can be shown at 1:12.5 scale.

Actual sectional diameter of bars, being always greater than nominal, should be considered when clear distance between bars is critical. General practice is to use an additional 10% bar thickness for deformed bars.

Table 16.1 – Reinforcing bar 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 in the same plane	
Bar lapped using a cranked bar	
Bar or stressing strand in section	

Figure 16.1(a) - Typical reinforcement detailing

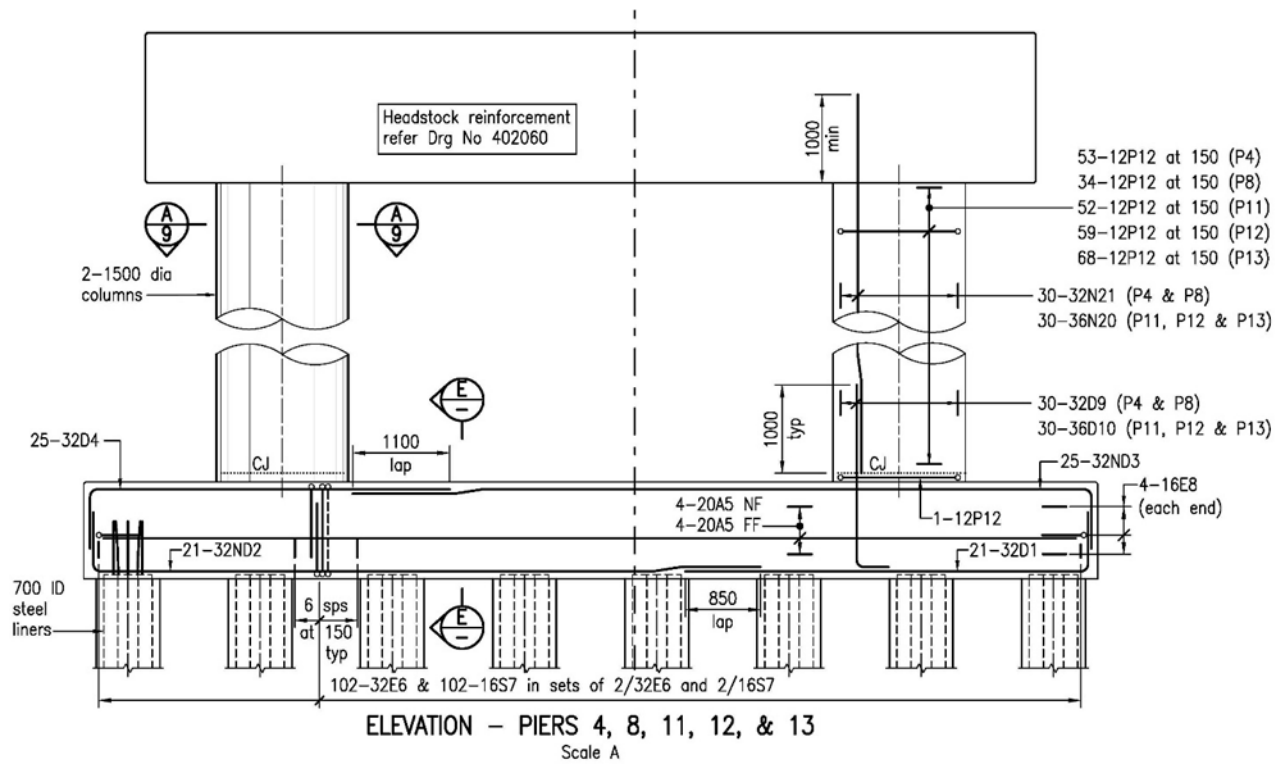


Figure 16.1(b) - Typical Multilayered Reinforcement

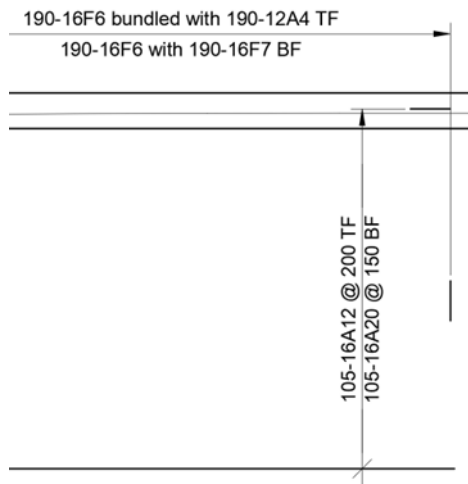


Figure 16.1(c) - Bars Bent On Site

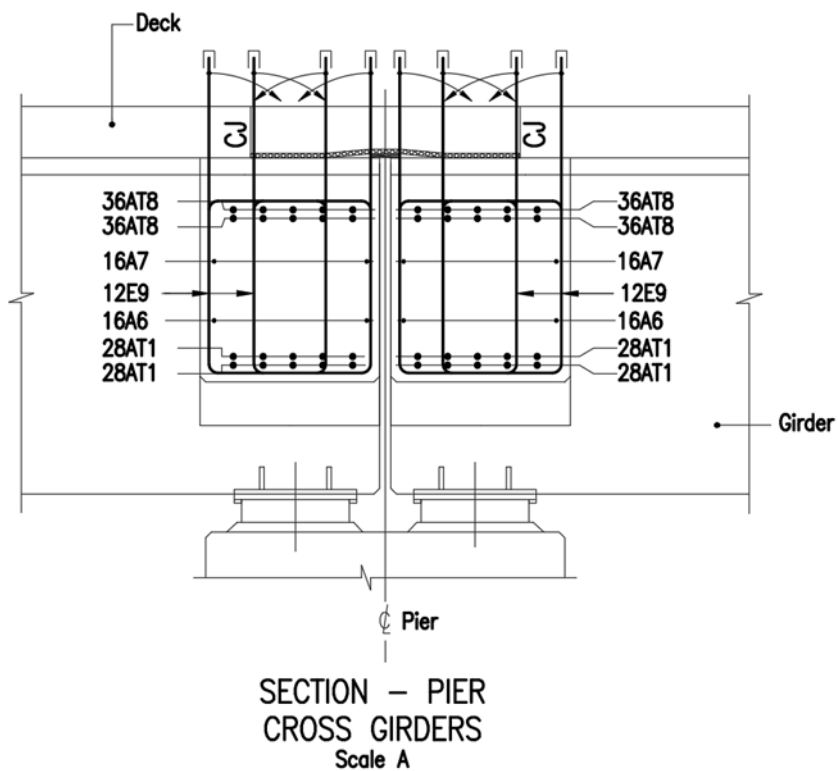
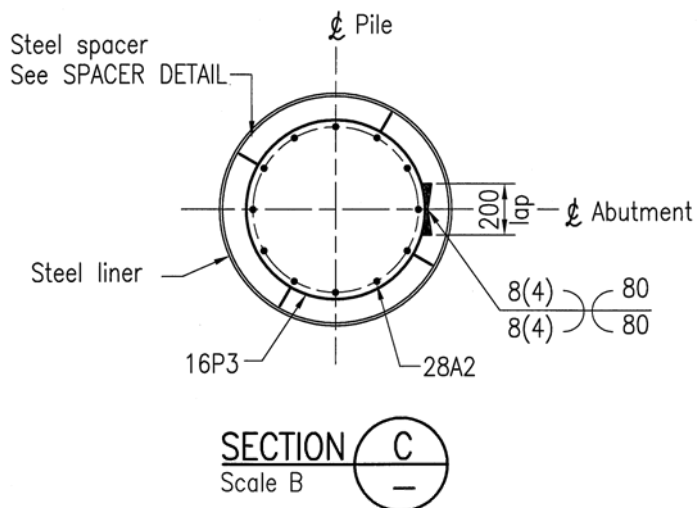


Figure 16.1(d) - Welded Laps



16.2 Reinforcing bar identification

Transport and Main Roads convention for calling up reinforcing bars is as shown in the following examples:

11-16A15-R-150-NF or 11-16A15R at 150 NF

Where:

11	= number of identical bars
16	= diameter of the bar
A	= bar shape
15	= sequence number (this is called “bar mark” in AS 1100.501)
R	= Grade R250N, and if grade is not shown the bar is grade D500N
150	= maximum design spacing
NF	= location

“at” or “@”, whichever is used in this instance, should be so for all the drawings.

Where multiple layers of the same reinforcement are detailed in different faces or layers of an element, the following nomenclature is to be used:

NF	= near face
FF	= far face
TF	= top face
BF	= bottom face
C	= centre of the concrete section.

NF and FF are usually for vertical faces such as bridge abutment wing walls, and TF and BF are usually for horizontal faces such as a slab base.

The nomenclature EF (each face) can cause confusion, and its use should be avoided. Instead of 4-12A1 EF, the set may be labelled as 4-12A1 NF and 4-12A1 FF.

16.3 Sequence numbers

All reinforcing bars must be assigned sequence numbers, and these numbers are to be shown on the drawings, regardless of whether steel schedules are included in the contract documentation.

The benefits are:

- the drafter can methodically cross-check between views for consistency
- enough information on the drawings to define all the bars for any future steel scheduling

- enough information on the drawings for good understanding of the design during reviews
- enough information so that if problems occur during fabrication or construction, the specific bars needing changes, such as modification, removal, or other actions, can be clearly identified
- clarity of the design for future structural analysis, design modifications, and so on
- documented evidence of quantities and placement for contract administration, and
- archival quality information on the As Constructed drawings, as steel schedules are generally not archived.

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

- numbers are assigned in ascending order starting at 1 for each element of a structure, for example, slab bases, columns, abutments, and concrete decks
- numbers should advance in order of placement from bottom to top, and
- numbers are not to be duplicated in an element unless those bars are identical.

16.4 Calling up and labelling

Bars are to be called up along a line between limit bars or by arrows to individual bars (refer to Figure 16.5).

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

11–16A15 at 150 maximum = 1400.

Bars are to be detailed in at least 2 views, sufficient to identify the number, shape, and limits of each bar type and its fitment, location, and orientation within the concrete element.

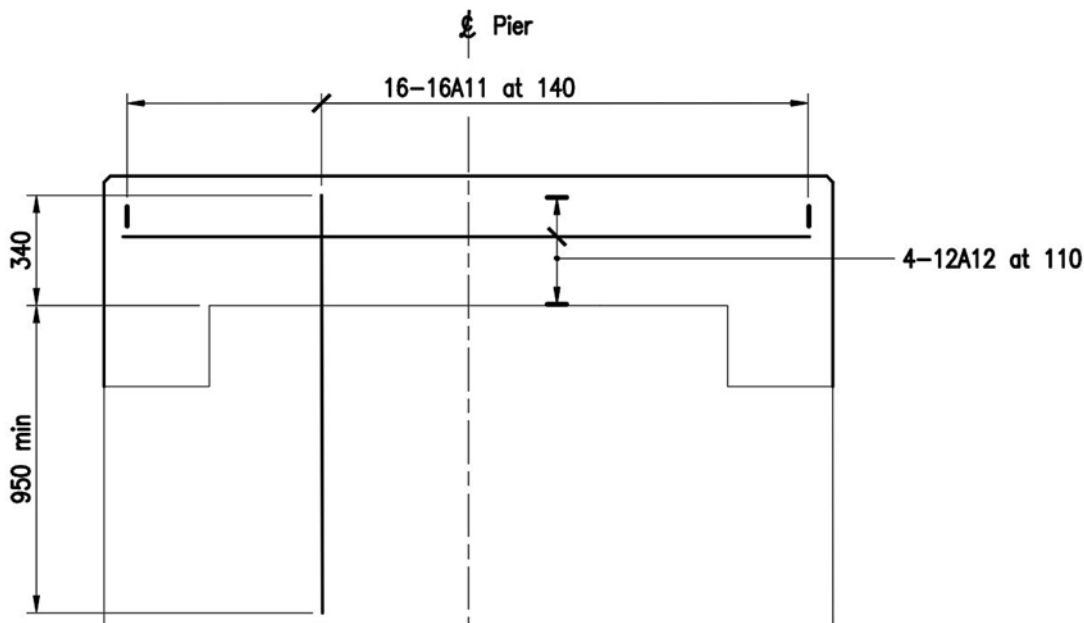
The total number for each bar type and sequence number should be called up on a single main view, if practical. If required to show totals on secondary views, such as a section or detail for reasons of clarity, then the total number of bars for that sequence number should not be shown on the main view.

16.5 Reinforcement dimensioning

Reinforcement dimensioning on the drawings at A1 size shall be as follows:

- Spacing to be bar centre to bar centre.
- Cover to be to the extremity of the designated bar.
- Extent of the slab reinforcement shown by limit lines drawn 5 mm long and 0.7 mm thick, and
- A reference line with a mark is to be drawn from the bar to the dimension line in all instances. The mark is to be a 5 mm long, 0.7 mm thick line at 45 degrees to the reference line starting at left below the dimension line and crossing to top right, looking normal to the text.

Figure 16.5 – Example of reinforcement call up on dimension lines



17 Structural Steel detailing

Structural steel drawings shall be in accordance with Section 3.3 of AS 1100.501 and Section 3.6 of Austroads *Guide to Bridge Technology – Part 5: Structural Drafting*.

Structural design considerations for departmental projects are discussed in DCBoS.

According to Section 3.6.1 of Austroads *Guide to Bridge Technology – Part 5*, structural steelwork drawings must include sufficient detail for the complete fabrication of a particular item or sufficient detail to enable the fabricator to prepare detailed shop drawings for that item.

Where items are to be bolted or welded together in the field (for example, where steel cross girders are to be attached to the main girders), an assembly drawing showing all component in their final position in the structure shall be provided.

Items requiring bolts, the spacing of bolts and bolt holes, and the edge distances to all plates shall be provided on the drawings.

Transport and Main Road's requirements for the drafting of standard steel elements such as steel liners for cast in place piles, steel post and rail bridge barriers, gantries, and other steel elements, are discussed further elsewhere in this volume.

Engineering drawings are prepared for fabricated steel elements, shop drawings are not required unless specifically mentioned in the design contract for more complex projects.

Figure 17.2(a) shows an example of a Steelwork Marking Plan drawing, and steelwork details drawings extracted from the steelwork drawings sub-set for a truss bridge.

17.1 Steelwork Marking Plans

For complex or large structures, a steelwork marking plan should be developed to show the arrangement of members diagrammatically, as single lines to represent each element, in plan and elevation views. The marking plan is the first drawing in the set, serving as a key diagram for the structure, and from which the detail drawings are developed.

These drawings should show:

- overall outline of the structure, drawn to scale, with levels and dimensions
- location of splices, lifting points
- set out of chords and diagonals
- steelwork member schedule listing the mark and material of each member
- pre-camber diagram, for girders and trusses, for example, and
- marking of steel members.

17.2 Steelwork Marking Nomenclature

Steelwork marking can be identified using one or a combination of the following 2 methods:

- steel member mark, and/or

- steel member size.

Steel elements using marks shall be assigned a unique distinct mark within the drawing package.

All steel element marks should maintain consistency across similar design packages.

Each steel element mark begins with a prefix that corresponds to the steel element component. A steelwork member schedule shall be included in the drawings that detail the steelwork members (refer to Table 17.2(b) for an example). This schedule should, at a minimum, include the mark and steel element designation for each unique element within the design package. Steel element designations shall comply with AS/NZS 3678, AS/NZS 3679.1, AS/NZS 3679.2, and AS/NZS 1163. A list of standard steel designation marks is provided in Table 17.2(a).

When a steel mark includes both alphanumeric and numerical codes, they should be separated by a hyphen ("-") between the Component ID and the mark, for example, "BG-1A". The typical designation for standard steel elements for all departmental structural drawings is shown in Table 17.2(a).

Table 17.2(a) – Designation of steel elements as per Table 3.4 of AS 1100.501

Section type	Abbreviation	Typical designation
Welded beam	WB	700WB115
Welded column	WC	500WC440
Universal beam	UB	610UB125
Universal column	UC	100UC14.8
Tee cut from UB	BT	75BT7.0
Tee cut from UC	CT	155CT79.0
Taper flange beams	TFB	100TFB
Parallel flange channel	PFC	150PFC
Taper flange channel	TFC	75TFC
Equal angles	EA	25 x 6 EA
Unequal angles	UA	65 x 50 x 5 UA
Flat bar	FL	150 x 50 FL
Round bar	ROD or RD	16 DIA ROD
Square bar	SQ	10 SQ
Circular hollow section	CHS	13.5 x 2.3 CHS

Section type	Abbreviation	Typical designation
Rectangular hollow section	RHS	250 x 150 x 9.0 RHS
Square hollow section	SHS	20 x 1.6 SHS
Cold-formed purlin	Z	Z10010
Cold-formed girt	C	C35030

An example of a steelwork member schedule required for all drawings using steel element marks is shown in Table 17.2(b).

Table 17.2(b) - Example of steelwork member schedule

Mark	Member
KB1	100 x 10 EA
PB1	125 x 12 EA
TB1	250 x 150 x 12.5 RHS
HB1	200PFC
DB1	250 x 12.5 SHS
DB2	200PFC
RB1	250UC72.9
BB1	65 x 50 x 5 UA
DP1	20mm diaphragm plate

Figure 17.2(a) - Example steelwork marking plan drawing

Department of Transport and Main Roads

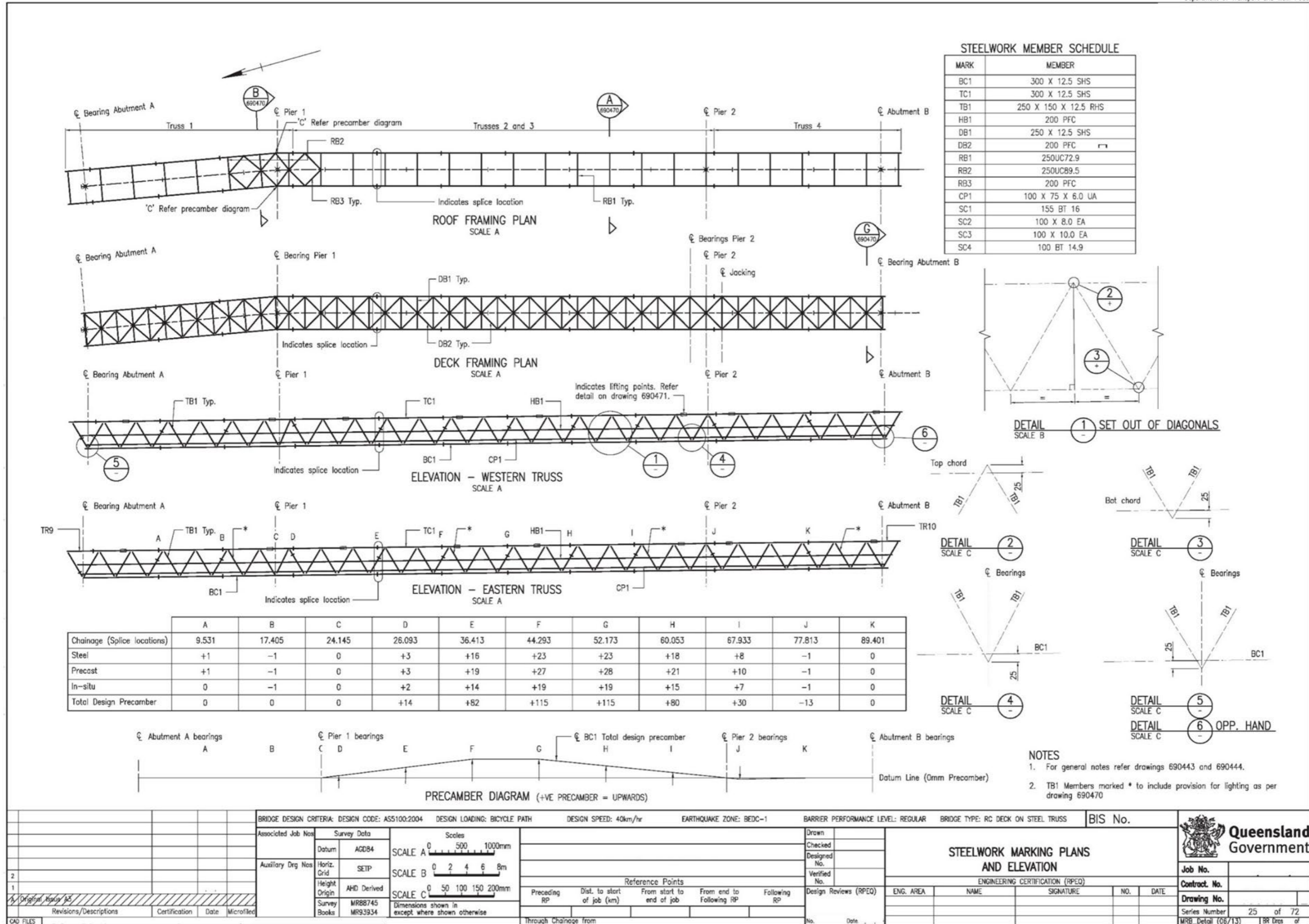


Figure 17.2(b) - Example drawing of steelwork plan views and elevations of truss

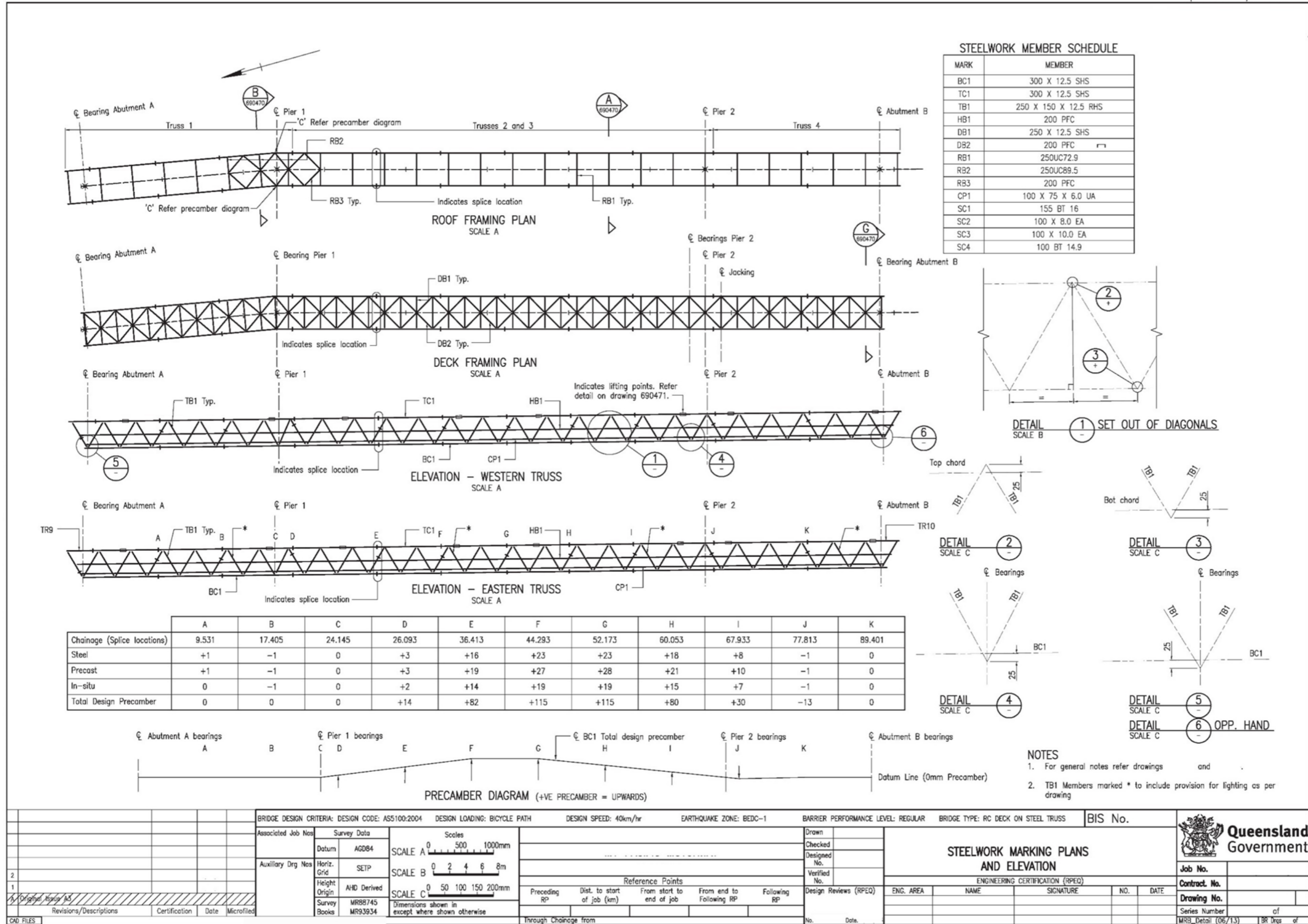
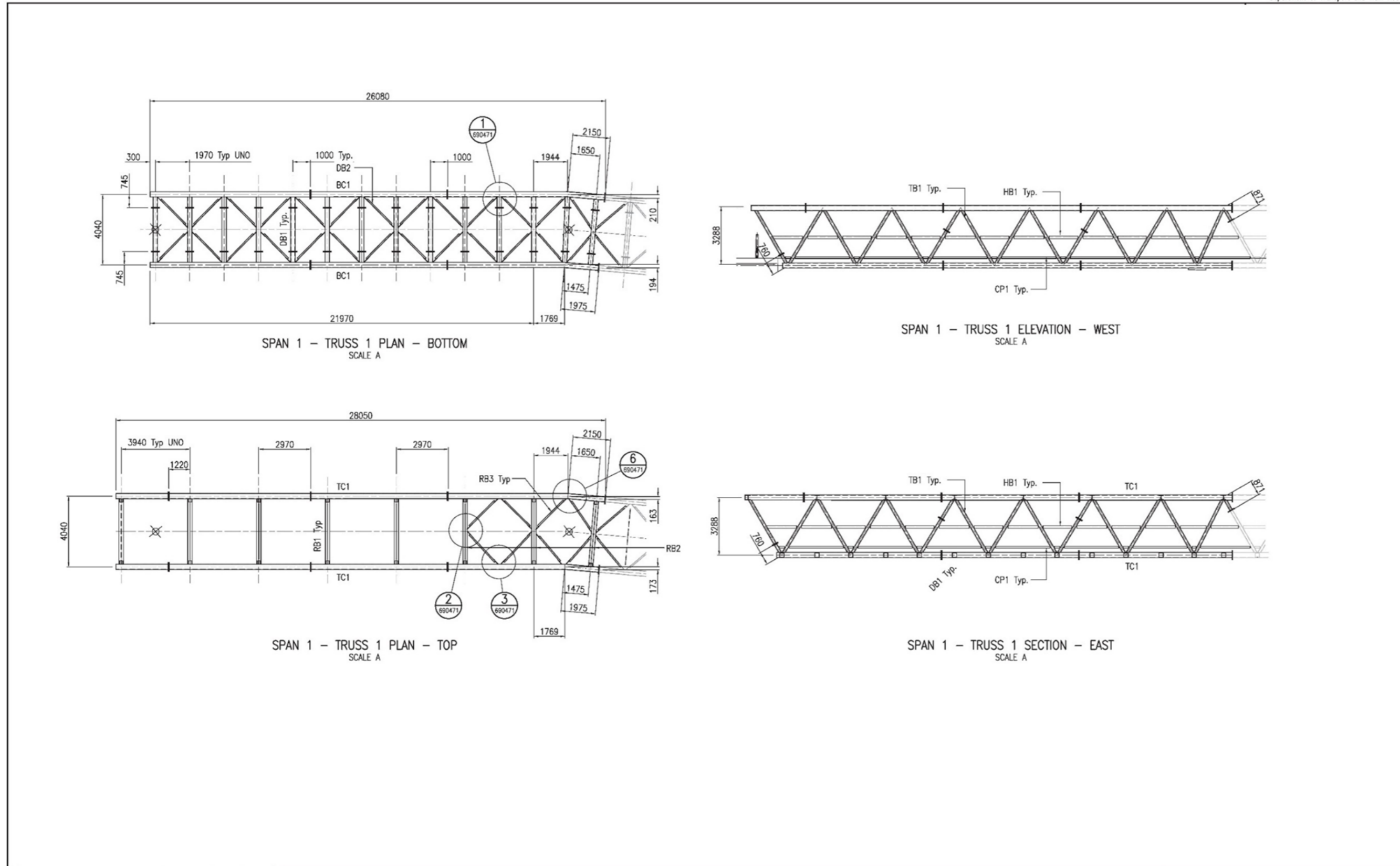


Figure 17.2(c) - Example drawing of steelwork sections and details of truss assembly

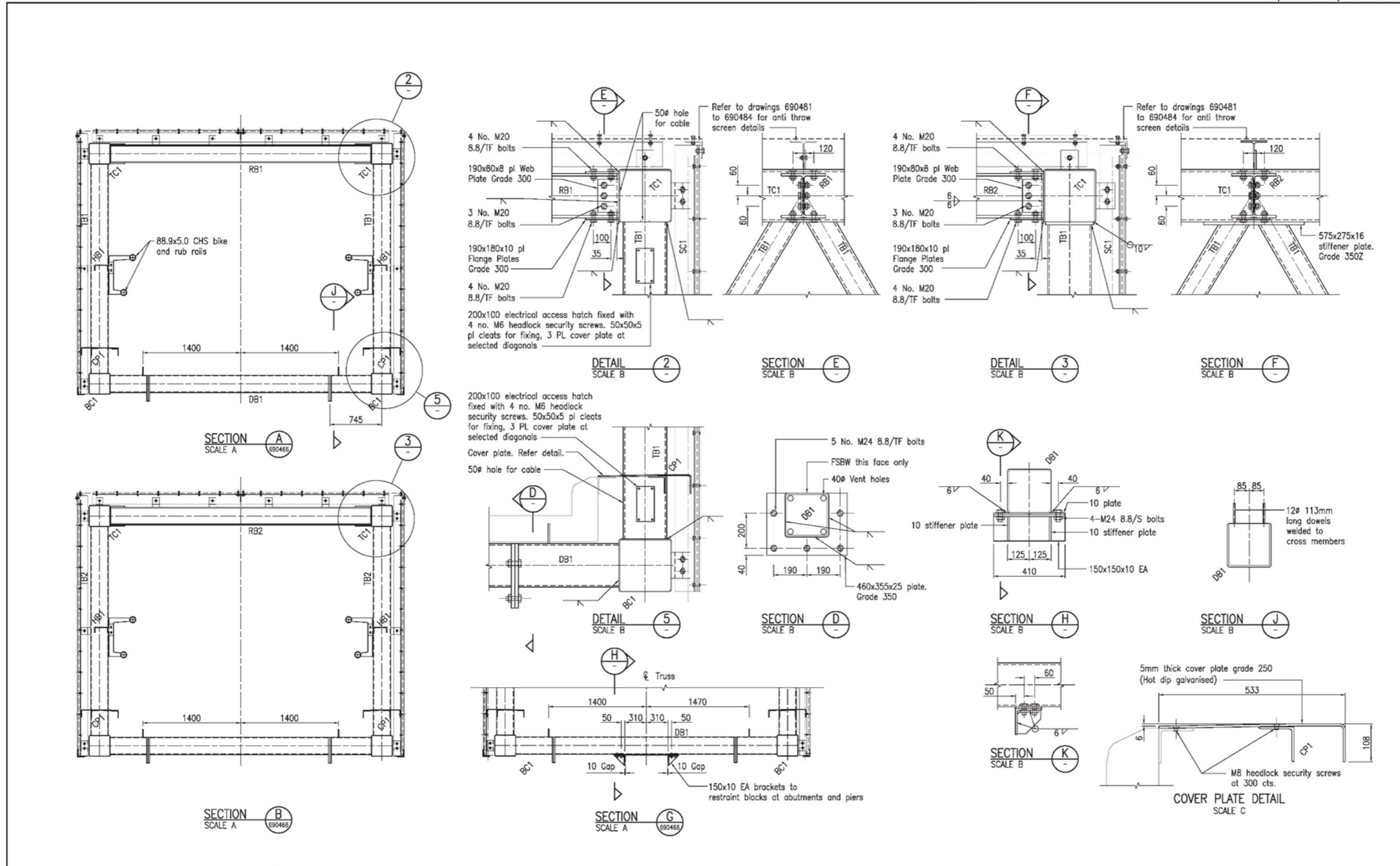
Department of Transport and Main Roads



BRIDGE DESIGN CRITERIA: DESIGN CODE: AS5100:2004				DESIGN LOADING: BICYCLE PATH				DESIGN SPEED: 40km/hr				EARTHQUAKE ZONE: BEDC-1				BARRIER PERFORMANCE LEVEL: REGULAR				BRIDGE TYPE: RC DECK ON STEEL TRUSS				BIS No.					
Associated Job Nos		Survey Date		Scales		Datum		AGD84		SCALE A		0 1 2 3 4m		Drawn		Checked		Designed		Verified		No.		Date					
Auxiliary Drg Nos		Horiz. Grid		SETP		Height Origin		AHD Derived		Survey Books		Dimensions shown in except where shown otherwise		Through Chainage from		Design Reviews (RPEQ)		ENG. AREA		NAME		SIGNATURE		NO.		DATE		STEELWORK DETAILS - SHEET 1	
2 Tender Re-issue		EH		15/07/16		1 Tender Issue		EH		10/06/16		Original Issue		No.		Date		No.		Name		Signature		No.		Date		Job No. Contract No. Drawing No. Series Number MRB_Detail (05/13) BR Truss of	

Figure 17.2(d) - Example drawing of steelwork - section and assembly details

Department of Transport and Main Roads



BRIDGE DESIGN CRITERIA: DESIGN CODE: AS5100:2004		DESIGN LOADING: BICYCLE PATH		DESIGN SPEED: 40km/hr		EARTHQUAKE ZONE: BEDC-1		BARRIER PERFORMANCE LEVEL: REGULAR		BRIDGE TYPE: RC DECK ON STEEL TRUSS		BIS No.	
Associated Job Nos		Survey Data		Scales		Reference Points		Design Reviews (RPEQ)		ENGINEERING CERTIFICATION (RPEQ)		Job No.	
Auxiliary Drg Nos		Datum: AGD84		SCALE A: 0 500 1000mm		Preceding RP		Checked		NAME		Contract No.	
1		Horiz. Grid: SETP		SCALE B: 0 100 200 300 400mm		Dist. to start of job (km)		Designed No.		SIGNATURE		Drawing No.	
2		Height Origin: AHD Derived		SCALE C: 0 50 100 150 200mm		From start to end of job		Verified No.		NO.		Series Number	
3		Survey Books: MR88745		Dimensions shown in except where shown otherwise		From end to Following RP		Design No.		DATE		MRB_Detail (06/13)	
4		MR93934				Through Chaining from		No.				BR Drgs of	
CAD FILES		Revisions/Descriptions		Certification		Date		Microfiled					

