Drafting and Design Presentation Standards
Volume 3: Structural Drafting Standards

Chapter 11: General Arrangement Drawings

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Chapter 11 Amendments

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Contents

11 General Arrangement Drawings ...................................................................................................1
11.1 Glossary of terms ..................................................................................................................1
11.2 Figures and examples shown in this volume .............................................................................1
11.3 Consistency in presentation ....................................................................................................1
11.4 Types of general arrangement drawings ................................................................................1
11.5 Concept general arrangement drawings ..............................................................................2
11.6 Preliminary design general arrangement drawings ............................................................8
11.7 Detailed design general arrangement drawings ....................................................................9
Appendix A - Example Concept General Arrangement Drawings .................................................19
Appendix B - Example Prelim Design General Arrangement Drawings ....................................20
Appendix C - Example Detailed Design General Arrangement Drawings – Sheet 1 ..................21
Appendix C - Example Detailed Design GA Drawings – Sheet 2 ....................................................22

Table 11.7-10 - Standard Figure 11.7-5 - Girder Layout Diagram Drawings .................................17

Figure 11.5-1 - Concept General Arrangement Drawing - Plan ......................................................3
Figure 11.5-2 - Concept General Arrangement Drawing - Elevation ............................................4
Figure 11.5-3 - Concept GA Drawing - Typical Section Deck Units ...............................................5
Figure 11.5-4 - Concept GA Drawing - Typical Section Girders .....................................................6
Figure 11.5-5 - Horizontal Curves ..................................................................................................7
Figure 11.5-6 - Vertical Curves .......................................................................................................7
Figure 11.7-1 - Deck Unit Anchorage Detail - No Provision for Jacking ........................................11
Figure 11.7-2 - Deck Unit Anchorage Detail - Provision for Jacking .............................................12
Figure 11.7-3 - Pile Identification and Setting Out Diagram ..........................................................13
Figure 11.7-4 - Deck Unit Layout Diagram .....................................................................................14
Figure 11.7-5 - Girder Layout Diagram ..........................................................................................14
Figure 11.7-6 - Type Piers .............................................................................................................15
Figure 11.7-7 - Type Abutments ...................................................................................................16
Figure 11.7-8 - Type Abutments with Rock Masonry .................................................................16
Figure 11.7-9 - Limits of HLP Vehicle ..........................................................................................17
Figure 11.7-11 - Pier Design Flood Force ....................................................................................18
11 General Arrangement Drawings

11.1 Glossary of terms

For a complete glossary of terms refer Chapter 1 Introduction.

General Arrangement drawings are informally referred to as GA’s as they will be in this chapter. On all drawings they are to be referred to with the full description and shall not be abbreviated.

11.2 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.

11.3 Consistency in presentation

As stated in Chapter 1 – Introduction, the purpose of this volume is to standardise the presentation of structural drawings, particularly TMR bridges, to achieve uniformity in appearance and detail for structural drawings.

This is important, particularly when drafting GA drawings, which can be drawn so that similar information is displayed consistently. For example:

- plan and elevation on the first sheet (or the first sheets in the event that the bridge is too long to fit on one drawing)
- bench mark/permanent survey mark information is always shown in the top left-hand corner of the first GA drawing along with a legend regarding foundation bore holes
- the catchment area is to be shown at the bottom right-hand side of the Plan view
- the notes are to be shown at the bottom right-hand side of the drawing.

11.4 Types of general arrangement drawings

GA drawings give an overall representation, at various phases of the project, of the bridge to be constructed. These phases are:

- concept
- preliminary design
- detailed design.

The level of detail provided at each phase will increase as the project progresses from concept through to detailed design.
11.5 Concept general arrangement drawings

The information available at the concept stage of the project can be limited. These drawings are used to provide different options that may be appropriate for the particular site and road design. The following views shall be provided:

- plan
- elevation
- section deck
- horizontal curve alignment (if available)
- vertical curve alignment (if available)
- concept drawing stamp (with issue date)
- title block (if various options are provided each drawing is to be clearly marked with the appropriate option, for example Option A, Option B etc.).

Each of these views shall provide all information available at that time.

Generally there will be one drawing, however depending on the overall length of the bridge there may be multiple drawings. Concept GA drawings are usually used to indicate the anticipated type of structure for the Region’s Business Case.

Refer Appendix A - Example Concept General Arrangement Drawings.

The following sections will explain each view in detail and look at some of the aspects to be addressed:

**Plan**

- outline of the structure
- crossfall or superelevation
- width between kerbs
- major towns (in each direction)
- contours of the existing surface
- property boundaries and fences
- public utilities and services
- abutments and Pier(s) centrelines
- relieving slabs
- approach and departure guardrail/extruded concrete barriers
- stream flow
- north Point
- road control line chainages
- the Road Control is to be shown on the left hand side of the Plan view along with the Bridge Control. The horizontal alignment, bearing or radius, shall also be shown
existing structures, to be shown in a dashed line, and with details such as span lengths, bridge width and composition. This is important particularly when a new bridge is being built on or near the same alignment as the existing bridge. Ensure the new piles are well clear of the existing piles taking into account any rake on the piles.

Refer Figure 11.5-1 - Concept General Arrangement Drawing - Plan.

**Figure 11.5-1 - Concept General Arrangement Drawing - Plan**

**Elevation**
- outline of the structure
- individual span lengths and overall length of the structure between abutments
- excavation to clear waterway
- vertical clearances for overpass bridges
- existing surface cross section taken along the Control Line
- existing structures
- datum height
- table of grade heights and vertical alignment details. Hts shall be shown at abutments and piers
  - table of surface heights. Show Heights at major changes in grade and at abutments and piers centrelines
- table of chainages. Show chainages for each surface Height and at abutment and pier centrelines
- hydraulic information including flood velocities and flood immunity Heights.
To obtain the relevant permits, the following additional hydraulic information shall be shown when the bridge spans a navigable waterway:

- Mean high water spring – The long term average of the Heights of two successive high waters during those periods of 24 hours (approximately once a fortnight) when the range of tide is greatest, at full and new moon.
- Mean low water spring – The long term average of the Heights of two successive low waters during those periods of 24 hours (approximately once a fortnight) when the range of tide is lowest, at full and new moon.
- Highest astronomical tide – The highest level that can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. This level will not be reached every year. Storm surges may cause considerably higher levels to occur.
- The clear span between abutments and piers.
- The clearance between the Highest Astronomical Tide and the underside of the deck units/girders.

The Elevation view can become very messy on skewed bridges. The view may be replaced with a Sectional Elevation if a true Elevation is not needed to show things such as varying pile depths.

Refer Figure 11.5-2 - Concept General Arrangement Drawing - Elevation.
Section deck

The section deck is a typical cross section taken through the bridge superstructure. Components that may be shown, but are not limited to include:

- bridge control
- deck units/girders, nominal gaps between the deck units/girders
- transverse stressing units
- RC deck
- grade height
- DWS and bituminous waterproof membrane
- crossfall or superelevation
- width between kerbs (overall width and dimensions to the Bridge Control)
- width of footways
- flow arrow
- bridge Barriers
- scuppers
- barriers
- jacking points for girder bridges.

Refer Figure 11.5-3 - Concept GA Drawing - Typical Section Deck and Figure 11.5-4 - Concept GA Drawing - Typical Section Girders.

Figure 11.5-3 - Concept GA Drawing - Typical Section Deck Units
Stability of PSC girders and deck units

The following text shall be shown on the General Arrangement drawing besides the section deck detail ‘THE CONTRACTOR IS TO SUBMIT A CONSTRUCTION PROCEDURE TO THE SUPERINTENDENT WITH REGARD TO ENSURING THE STABILITY OF PSC GIRDERs DURING CONSTRUCTION’

Drilling of holes into deck units

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’

Horizontal curve alignments

- bearings before and after the curve
- radius of the curve
- tangent points (including chainage and co-ordinates)
- intersection points (including chainage and co-ordinates)
- location of the bridge in relation to the curve
- any other curve that may have an impact on the structure (within approximately 200 metres of the abutments).

Refer Figure 11.5-5 - Horizontal Curves.
**Figure 11.5-5 - Horizontal Curves**

- grade before and after the curve
- radius of the curve and direction of the curve (sag or crest)
- tangent points (including chainage and Heights)
- intersection points (including chainage and Heights)
- location of the bridge in relation to the curve
- any other curve that may have an impact on the structure (within approximately 200 metres of the abutments).

Refer Figure 11.5-6 - Vertical Curves.

**Figure 11.5-6 - Vertical Curves**
The horizontal and vertical curve details illustrate possible implications on the structure, for example a horizontal curve within 200 metres of the bridge may have implications on the superelevation of the structure or possible implications on the width of the structure.

### 11.6 Preliminary design general arrangement drawings

At the preliminary design phase more information becomes available, for example final horizontal and vertical alignments, preliminary geotechnical data, hydraulic design etc.

The span length of the bridge will be fixed, as will the width between kerbs. Bridge Fixing is when the Directors of both TMR Structures and TMR Hydraulics sign off on the length, width, Height and type of bridge.

More detailed GA drawings can now be drawn. The concept drawings, if available, can be updated with the current information. In addition to the views already shown on the concept drawings, other views may be added to create the Preliminary Design GA drawing. These include, but are not limited to:

- Any of the views discussed in Section 11.5 – *Concept General Arrangement Drawings*.
- Which require information that was not available at that time.
- Outline of the abutment spillthroughs and the embankment slopes. Also note if the new embankments intrude into the traffic lanes of the existing road. When they do, solutions include stage construction of the new bridge, temporary retaining walls for the embankments, or side tracking of the bridgeworks.
- Preliminary drawing stamp (with issue date).
- Type Abutments and Piers showing the anticipated structure (this is only required when a preliminary cost estimate is requested by the client). The Type Abutments and Piers views show the type of substructure that the estimate is based on. For example, if the estimate includes driven piles then the views should indicate driven piles because this type of substructure is substantially less expensive than cast in place piles. For drawing requirements refer Section 11.7 – *Detailed Design General Arrangement Drawings*.
- Proposed geotechnical bore hole location table (if required). If bore holes have not been drilled already, a table showing the co-ordinates of the proposed locations shall be shown. Refer to the TMR Bridge Design Criteria for Bridges and other Structures for an explanation of the number of bore holes required at each abutment and pier centreline. The bore holes shall be positioned under the bridge barrier on both sides of the bridge. The proposed bore holes shall be shown in the Plan view. The co-ordinates shall be rounded to the nearest 0.1 m.

The Drafting Manager shall send the Preliminary Design GA drawing with a Bridge Fixing Letter to all stakeholders so that everyone is aware of the final fixing of the bridge. The stakeholders include Geotechnical Services Branch, who use the drawing to enable them to drill bore holes close to the abutment and pier locations, thus enabling accurate geological information to be used in the detailed engineering design of the structure. They may also include the drawing in their Geotechnical Report.

Refer Appendix B - Example Prelim Design General Arrangement Drawings.
11.7 *Detailed design general arrangement drawings*

At the detailed design phase, all necessary information should be available to draft the final GA drawings for the project. Refer Appendix C - Example Detailed Design General Arrangement Drawings.

The Preliminary Design GA drawings can be updated with all final information to create the Detailed Design GA drawings. In addition to all views on the Preliminary Design GA drawings, other views shall be added. These may include, but are not limited to:

- all relevant details previously mentioned in regards to Concept and Preliminary Design GA drawings
- note “Embankments to be in place prior to pile driving. Prebore with …. dia auger to natural surface height” to be placed in a box on the left hand side of Abutment A
- deck unit Anchorage details
- deck unit construction sequence
- pile identification and setting out diagram
- deck unit or girder layout diagram
- type abutments and piers
- limits of HLP vehicle diagram
- table of Standard Drawings
- pier design flood force data, including flood velocities and immunity heights
- notes
- procedures.

The following sections will explain each view in detail and look at some of the aspects to be addressed.

**Plan**

All text is to be clear and concise when read at A3 drawing size. If text is placed over features of the drawing, for example contour lines, embankment lines, hatched areas etc., these features are to be blocked out. In AutoCAD this is referred to as a wipeout.

It is not necessary to show abutment and pier chainages in this view, but the Plan view must be aligned vertically above the Elevation view below.

Features may include, but are not limited to:

- Two Bench Marks or Permanent Survey Marks shall be shown in the top left-hand corner along with the type of survey mark, its co-ordinates, Height and Height datum, for example PSM 166915, Star Picket, E274125.225, N2329910.650, Ht 3.970 AHD.
- Existing fences and property boundaries. Note any conflict that bridge components, such as embankment spillthroughs, may have on property boundaries.
- Catchment area in the bottom right-hand side of the Plan view.
All services such as electricity cables above or below ground, water mains, telecommunication cables etc. Particular reference shall be made for any service that may have an impact on the construction of the bridge. Clearly nominate the services and how they are treated, for example de-energised, relocated etc.

- Actual (not proposed) bore hole locations as detailed in the Geotechnical Report.
- Define excavation to clear waterway by hatching. For maintenance and inspection requirements a minimum clearance of 1200 mm is required between underside of deck units/girders and the ground surface at the abutments. The resulting embankment slopes from the excavated area up to the natural surface shall be a maximum gradient of 1 on 2. Refer Chapter 13 – *Provision for Bridge Jacking, Inspection and Maintenance*, Section 13.7- Abutment Protection.

**Elevation**

The elevation gives details of Grade Heights, Surface Heights and Chainages along the Road Control. If this view is shown along any other alignment the line of section is to be clearly noted.

Features may include, but are not limited to:

- services above or below the natural surface
- heights to PSC pile tips, toe of steel liners, toe of cast in place piles, soffit of pilecaps and footings
- preboring requirements. Show a boxed note describing the location, size of auger and give a Height at the toe of prebore. Generally the diameter of the auger is 50 mm less than the nominated size of the PSC pile
- maximum reported flood Height and date
- recent water height and date
- articulation of the bridge. Fixed bearing, continuous joint or expansion bearing shall be shown at the centreline of the abutments and piers along with an explanation of the symbols used as shown below (placed on the left of the view):
  - F denotes Fixed Bearing
  - E denotes Expansion Bearing
  - C denotes Continuous Joint.

**Section deck**

In addition to the detail previously mentioned in regards to Concept and Preliminary Design GA drawings, show the mass of DWS and the conduit details (if required).

**Deck unit anchorage details**

Deck Unit bridges require anchorage details at abutments and piers. For girder bridges these details are shown on the Miscellaneous Details drawing, refer Chapter 14 – *Prestressed Concrete Girders*, Section 14.7-Girder Anchorage Details.
Anchorage details show the assembly details at abutments and piers. Features may include, but are not limited to:

- abutment and pier headstocks, deck units, girders, relieving slabs, RC deck, DWS etc.
- detail of the anchorage system used, for example, dowels, threaded rod or holding down bolts on deck unit bridges or restraint angles on girder bridges
- provision for future jacking
- limits of mortar seating and its nominal thickness
- bearings and recesses for bearings. Note that when deck units/girders are supported by bearings at fixed abutment joints, an XJS expansion joint (or approved equivalent) shall be provided in the DWS. Refer Chapter 17 – *Cast Insitu Kerbs and Decks, Appendix A - Deck Design Sketches – Sheet 2*
- positioning of jacks for future bridge maintenance
- areas to be grouted, or left clear of grout
- expansion joints
- compressible filler.

Refer Figure 11.7-1 - Deck Unit Anchorage Detail - No Provision for Jacking and Figure 11.7-2 - Deck Unit Anchorage Detail - Provision for Jacking.

*Figure 11.7-1 - Deck Unit Anchorage Detail - No Provision for Jacking*

*Figure 11.7-2 - Deck Unit Anchorage Detail - Provision for Jacking*
Deck unit erection construction sequence

When precast deck units are erected on elastomeric bearings, the erection procedure notes and appropriate diagram are shown. Refer Chapter 13 – Provision for Bridge Jacking Inspection and Maintenance, Section 13.5 – Deck Unit Erection Construction Sequence.

Pile identification and setting out diagram

The pile identification and setting out of the piles shall be shown on the GA drawings. The Pile Identification and Setting out Diagram is generally not drawn to scale, but it shall have reasonable proportions and shall show the following details:

- bridge control and its bearing, or the radius of the horizontal curve
- the centreline of the pile group at abutment and piers shall be defined by a bearing and where it intersects the Bridge Control line shall be identified by a co-ordinate
- pile identification number for each individual pile
- dimensions to locate each pile
- relationship of footings to Bridge Control and abutment and pier centrelines
- relationship of stage construction to Bridge Control.
All piles shall be identified by a Pile Identification Number shown adjacent to the pile it represents. The format of the number is @/# where:

- @ = an alphanumeric character or number that represents the element of the bridge, for example A for Abutment A, B for Abutment B and one for Pier one
- # = a sequential number given to each pile counting from the left hand side of the bridge.

The spacing of the first pile from the Bridge Control along the centreline of the group of piles shall be dimensioned from the Bridge Control line, Dimension A. The spacing of each subsequent pile along the centreline of the group of piles shall be dimensioned from the previous pile, Dimension B.

Where raked piles are used, a note shall be added to the drawing stating that the location shown is at the underside of the headstock/pilecap into which the pile is cast. Raked piles are also to have the slope of the rake noted together with an arrow showing the direction of the rake.

Refer Figure 11.7-3 - Pile Identification and Setting Out Diagram.
Deck unit or girder layout diagram

The Layout Diagram is generally not drawn to scale, but it shall have reasonable proportions.

For a simple layout where each span has the same deck unit or girder types, they can be identified on the Section Deck. Refer Figure 11.5-3 - Concept GA Drawing - Typical Section Deck Units.

When deck unit types vary from span to span, due to expansion joints, continuous deck joints and so on, a pictorial plan view of all bridge spans shall be shown with the deck unit types clearly identified. Refer Figure 11.7-4 - Deck Unit Layout Diagram.

**Figure 11.7-4 - Deck Unit Layout Diagram**

![Deck Unit Layout Diagram](image)

For girder bridges these details are shown on the Miscellaneous Details drawing when the diagram is used to layout steelwork as well as the girders. Refer Figure 11.7-5 - Girder Layout Diagram.

**Figure 11.7-5 - Girder Layout Diagram**

![Girder Layout Diagram](image)
Type abutments and piers

Type Abutments and Piers views do not show the pile spacing or pile foundation Heights. Refer Figure 11.7-6 - Type Piers and Figure 11.7-7 - Type Abutments. These views give a pictorial view of each structure and shall show:

- Number, type and size of piles supporting each structure.
- Outline of the headstock.
- Abutment Protection – Type 1 - Rock Spillthrough refer TMR Standard Drawing 1540 or 1541. If the protection conforms to a standard drawing only the toe wall dimensions need to be detailed. If the protection is non-standard, all off the non-standard details shall be detailed and all other details shall be referenced back to the standard drawing.
- Abutment Protection – Type 2 - Reinforced Concrete Over Spillthrough refer TMR Standard Drawing 1542 or 1543. If the protection conforms to a standard drawing only the toe wall dimensions need to be detailed. If the protection is non-standard, all off the non-standard details shall be detailed and all other details shall be referenced back to the standard drawing.
- Abutment Protection – Type 4 - Rockwork Over Spillthrough refer TMR Standard Drawing 1544 or 1545. If the protection conforms to a standard drawing only the toe wall dimensions need to be detailed. If the protection is non-standard, all off the non-standard details shall be detailed and all other details shall be referenced back to the standard drawing.
- Abutment Protection - Rock Masonry refer TMR Standard Drawing 1548. All rock masonry details shall be shown on the Type Abutments view. The standard drawing shows the details required. Refer Figure 11.7-8 - Type Abutments with Rock Masonry.

Figure 11.7-6 - Type Piers
Figure 11.7-7 - Type Abutments

ELEVATION

Figure 11.7-8 - Type Abutments with Rock Masonry

ELEVATION
Limits of HLP vehicle diagram

All bridges wider than 8m between kerbs, which are designed with HLP capability shall display a diagram showing the allowable deviation of a HLP vehicle on the bridge.

Show the following details:

- pictorial cross section of deck
- allowable HLP dimensions from the Bridge Control to the outside of vehicle
- minimum clear distance from the HLP to the kerb face.

Generally, the lateral travel of the HLP vehicle is limited to half the width of the HLP plus 1m into the outside traffic lane on the bridge.

Minimum clear distances to kerbs should be calculated on this basis.

The design engineer must advise if this is not the case so the detail can be amended. The width of HLP 320 vehicle is 3600 and the width of HLP 400 vehicle is 4500.

*Figure 11.7-9 - Limits of HLP Vehicle*

![Limits of HLP Vehicle Diagram]

Table of Standard Drawings

Tabulate all standard drawings associated with the project. These drawings shall be marked “included” in the Standard Documents List in the contract documents.

Also include the version (date) of the standard drawing.

*Table 11.7-10 - Standard Drawings*

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<td>STANDARD PVC SCUPPER</td>
</tr>
<tr>
<td>1172</td>
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<td>BRIDGE APPROACH RELIEVING SLAB</td>
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**Pier design flood force**

On all multiple span bridges subject to stream flow, a boxed note shall be placed adjacent to the Elevation view showing the Ultimate Pier Design Flood Force, applicable Height, Design Flood Velocity and ARI.

*Figure 11.7-11 - Pier Design Flood Force*

<table>
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<th>Ultimate Design Flood Force at Piers</th>
<th>150kN @ Ht 3.440</th>
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<td>Design Flood Velocity = 1.5 m/s</td>
<td>(ARI = 50 yrs)</td>
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**Notes**

Notes shall be placed in the bottom right-hand corner of the first GA drawing. If they don’t fit there, they shall be moved to another GA drawing. Refer Chapter 5 – *Notes*.

**Procedures**

If appropriate, the following details are required:

- stage construction detailed views and procedure
- erection procedure
- construction procedure.
Appendix A - Example Concept General Arrangement Drawings