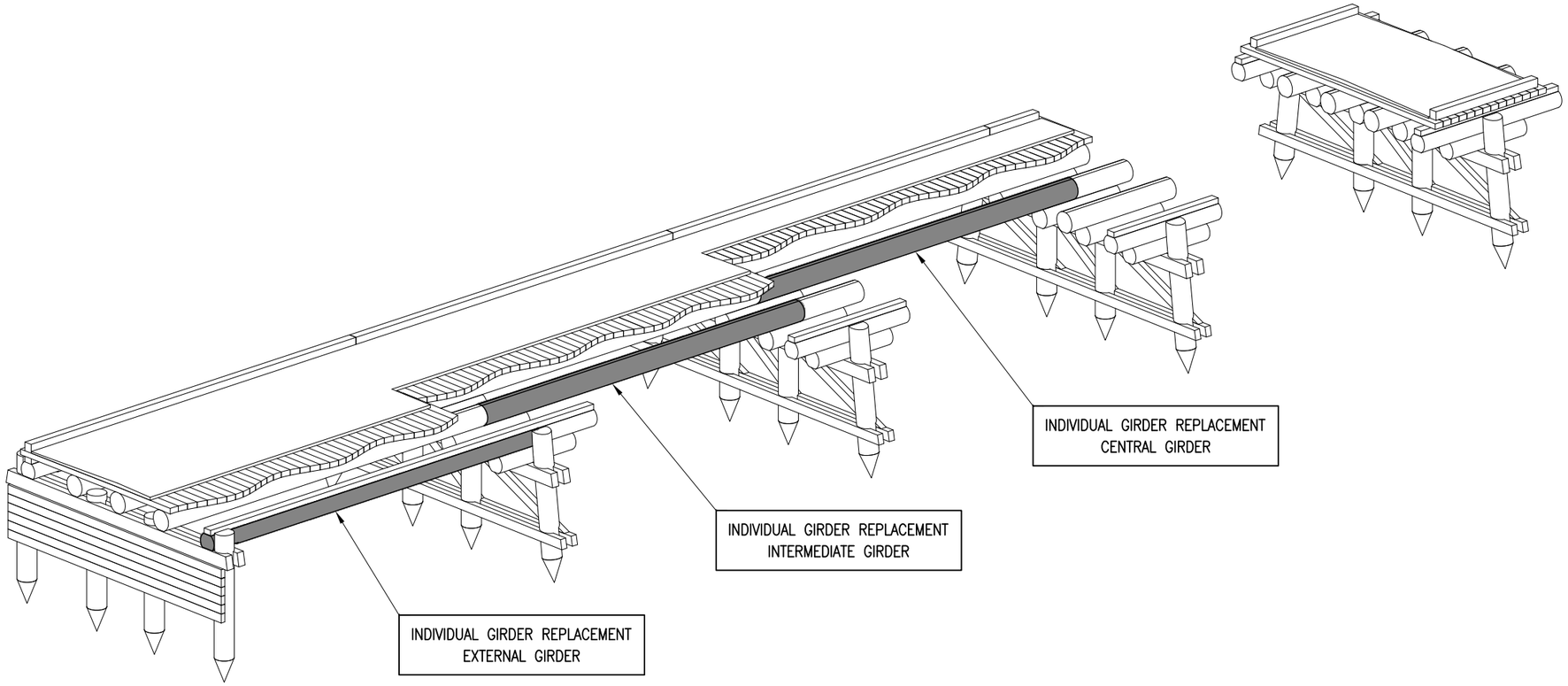
FIBRE REINFORCED POLYMER (FRP) COMPOSITE GIRDERS FOR TIMBER BRIDGE REHABILITATION



TYPICAL ARRANGEMENT "A" CLASS TIMBER BRIDGE (1939)

DRAWING INDEX

ACRONYMS

TPA	Top Plate Assembly
CW	Channel web stiffener
B1 TO B4	Bolts for external girder replacement
B5 TO B8	Bolts for intermediate girder replacement
B9 TO B12	Bolts for central girder replacement
DF	Deck Flat Bar
RBA	Restraint Bracket Assembly
RBU	Restraint Bracket Upper assembly
RBM	Restraint Bracket Middle assembly
RBL	Restraint Bracket Lower assembly
FRP	Fibre Reinforced Polymer
FRPC	Fibre Reinforced Polymer Composite
JP	Jacking Plate
SW	Saddle Washer
HWS	Hardwood Web Stiffener
HWP	Hardwood Packer

Australian Standards:

AS 1101.3	Graphical symbols for general engineering – Welding and non–destructive examination
AS 1111.1	ISO metric hexagon bolts and screws – Product grade C – Bolts
AS 1112.1	ISO metric hexagon nuts – Style 1 – Product Grade A and B
AS 1112.4	ISO metric hexagon nuts – Chamfered thin nuts – Product grades and B
AS 1163	Cold–formed structural steel hollow sections
AS 1214	Hot–dip galvanized coatings on threaded fasteners (ISO metric coarse thread series)
AS 1237.1	Plain washers for metric bolts, screws and nuts for general purposes – General plan
AS/NZS 1252	High strength steel bolts with associated nuts and washers for structural engineering
AS/NZS 1554.1	Structural steel welding – Welding of steel structures
AS/NZS 3678	Structural steel – Hot–rolled plates, floorplates and slabs
AS/NZS 3679.1	Structural steel – Hot–rolled bars and sections
AS/NZS 4680	Hot–dip galvanized (zinc) coatings on fabricated ferrous articles
AS/NZS ISO 14341	Welding consumables – Wire electrode and weld deposits for gas shielded metal arc welding of non alloy and fine grain steels – Classification
AS/NZS ISO 17632	Welding consumables – Tubular cored electrodes for gas shielded and on–gas shielded metal arc–welding of non–alloy and fine grain steels – Classification

GENERAL NOTES:

G1. The details shown on this standard drawing are for individual girder replacement only using FRPC girders designed and manufactured by Wagners (Wagners girders) for the "Bridging the Gap" project. This standard drawing is not applicable for any other use.
G2. Refer Standard drawing 2286 for installation procedure
G3. This Standard Drawing is applicable for the following cases:
- Single girder requiring replacement in one span
- Bridges with a timber sub–structure and the following class:
  * 'A' and 'Am' class bridge up to 30' spans – edge girder replacement
  * 'A' and 'Am' class bridge up to 27' spans – edge or interior girder replacement
  * 'B' and 'Bm' class bridge up to 30' spans – edge or interior girder replacement
- Bridges with no traffic barriers attached directly to edge girder

G4. Maximum one FRPC girder replacement per span using Wagners Girders denoted as WCFT–S1, S2 or S3 in this drawing.
G5. The scope of the FRPC girder replacement for timber bridges standard drawings is to define situations where approved FRPC girders may be used as timber girder replacements in the rehabilitation of existing timber bridges.
G6. Consideration needs to be given to lateral and longitudinal restraint and some samples of typical restraint systems are detailed on these drawings. When timber girders are replaced, props may be required to provide stability to adjacent span. In each case, calculations need to be performed to assess the design for each project.
G7. All dimensions listed in these drawings are to be confirmed on site prior to construction.

STEELWORK NOTES:

S1. STEELWORK to be fabricated to the requirements of MRTS78
SHS to be Grade C350L0 to AS/NZS 1163.
Steel plate to be Grade 350 to AS/NZS 3678.
Flat bar to be Grade 300 to AS/NZS 3679.1.
Bolts Class 4.6 to AS 1111.1, nuts Class 5 to AS 1112.1 and washers for Class 4.6 bolts to AS 1237.1.
Bolts Class 8.8, nuts Class 8 and washers for Class 8.8 bolts to AS/NZS 1252, thin nuts Class 5 to AS 1112.4.
All bolts and nuts to be hot dip galvanized to AS 1214. All other steelwork to be hot dip galvanized to AS/NZS 4680 unless shown otherwise. Prior to galvanizing all weld splatter and welding slag is to be removed.
S2. WELDING symbols conform to AS 1101.3.
All welding to AS/NZS 1554.1.
All welds, except location tack welds, to be SP category.
Welding consumables to be controlled hydrogen type G493 to AS/NZS ISO 14341–B or T493 to AS/NZS ISO 17632–B, unless shown otherwise.
S3. DIMENSIONS are in millimetres unless shown otherwise.

TIMBER NOTES:

T1. All Timber Packers to be:
Seasoned Hardwood
Stress Grade F27
Joint Group JD1
Minimum Strength Group SD2

ASSOCIATED DEPARTMENTAL DOCUMENTS:
Standard Drawings
Specifications
Timber Bridge Maintenance Manual

REFERENCED DOCUMENTS:
Departmental Standard Drawings:
2286 FRP Composite Girders for Timber Bridge Rehabilitation – WCFT–S1, S2 & S3 Installation Procedure
Departmental Specifications:
MRTS78 Fabrication of Structural Steelwork
MRTS60 Installation of Fibre Reinforced Polymer (FRP) Composite Girders

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FRP COMPOSITE GIRDERS FOR TIMBER BRIDGE REHABILITATION

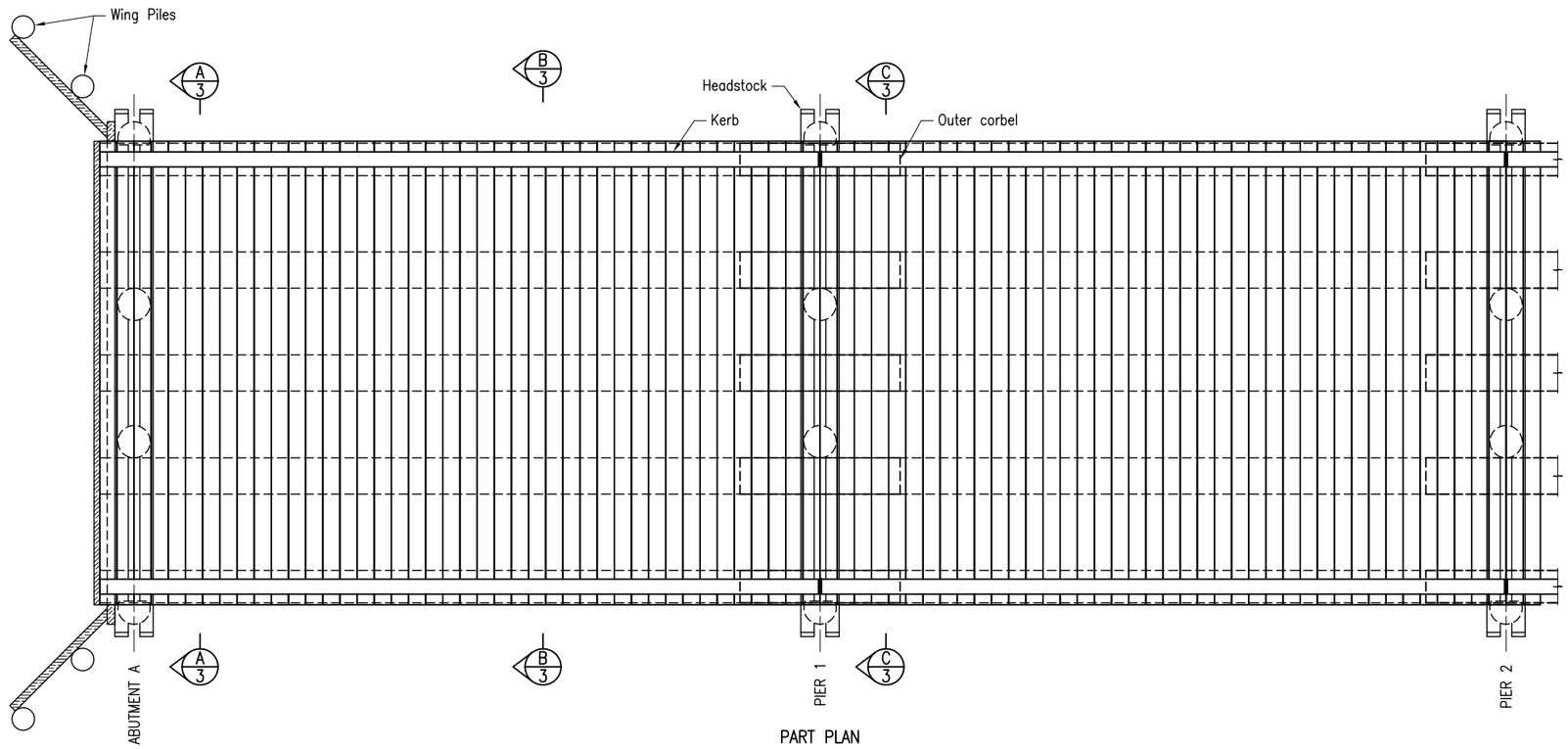
WCFT–S1, S2 & S3
INSTALLATION DETAILS
SHEET 1 of 17

Queensland Government

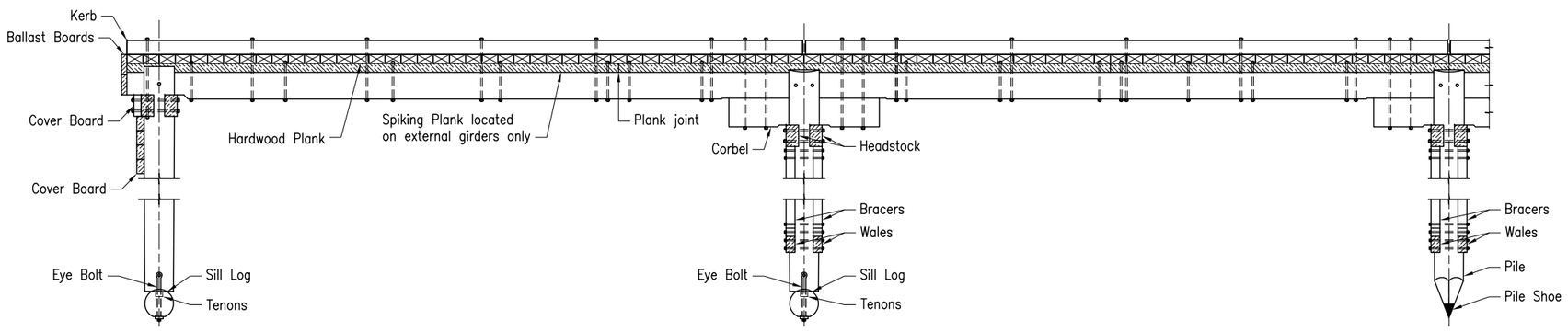
A3
Not to Scale

Standard Drawing No
2285
Date 7/15

A



PART PLAN



ABUTMENT A

PIER 1 (with Sill Log)
(Bolt spacing applies only to external girders only)

PIER 2 (without Sill Log)

PART ELEVATION

TYPICAL DETAILS – EXISTING 30'x18' WIDE TIMBER SUBSTRUCTURE & SUPERSTRUCTURE*

*Dimensions to be confirmed on site

NOTES:
1. General Arrangement for a five girder timber bridge.
2. Bituminous DWS on top of wood deck (not shown on PLAN view for clarity)

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FRP COMPOSITE GIRDERS
FOR TIMBER BRIDGE REHABILITATION

WCFT–S1, S2 & S3
INSTALLATION DETAILS
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Queensland Government

A3
Not to Scale
A

Standard Drawing No
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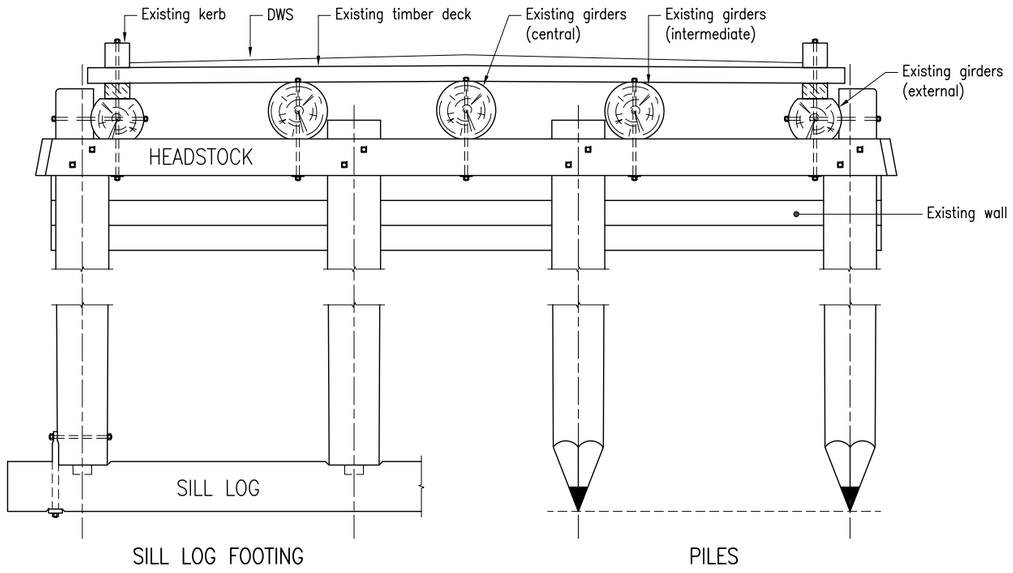
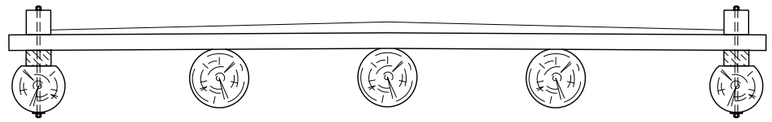
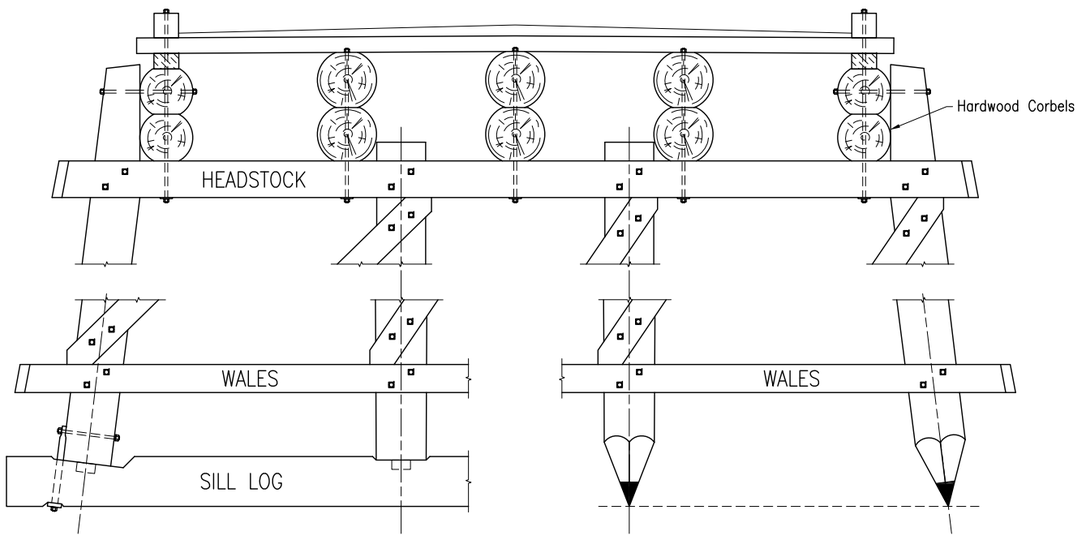
Date 7/15



SECTION A/2 EXISTING ABUTMENT DETAIL



SECTION B/2 EXISTING MID SPAN DETAIL



SECTION C/2 EXISTING PIER DETAIL

NOTES:
1. General Arrangement for a five girder timber bridge.

Department of Transport and Main Roads

FRP COMPOSITE GIRDERS FOR TIMBER BRIDGE REHABILITATION

WCFT–S1, S2 & S3
INSTALLATION DETAILS
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A3
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A

Standard Drawing No
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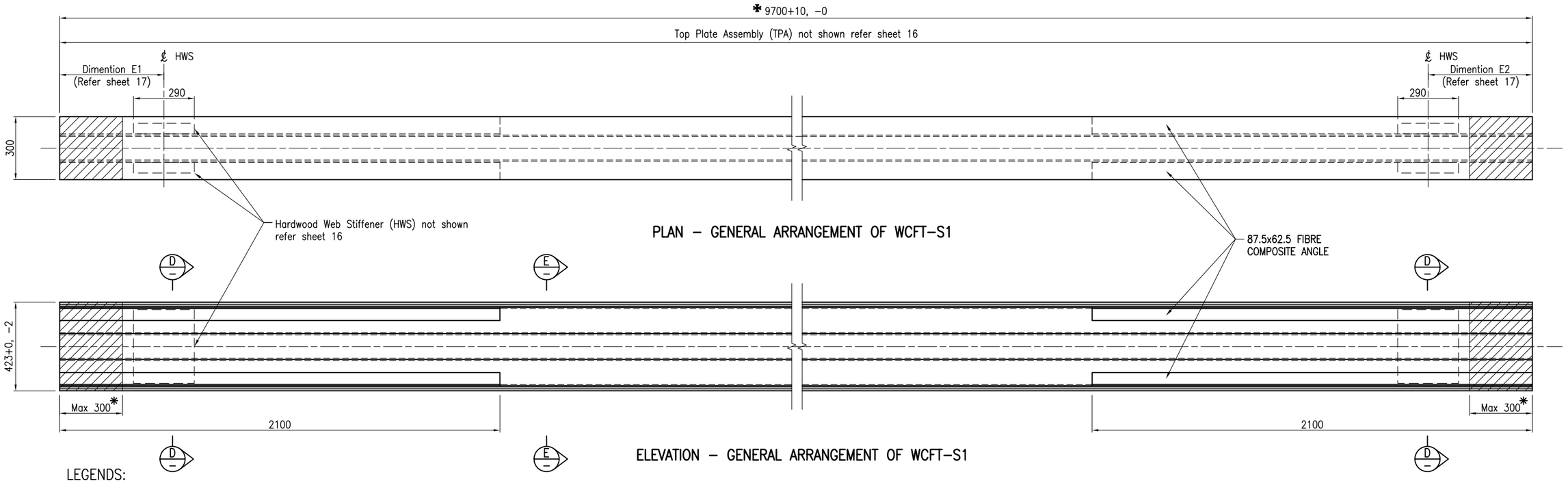
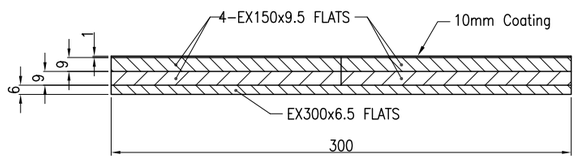


PLAN – GENERAL ARRANGEMENT OF WCFT–S1

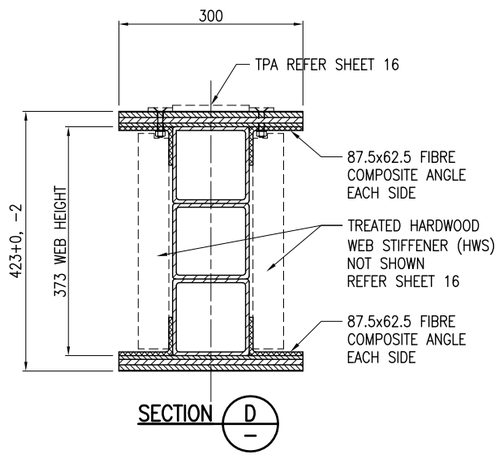
ELEVATION – GENERAL ARRANGEMENT OF WCFT–S1

LEGENDS:

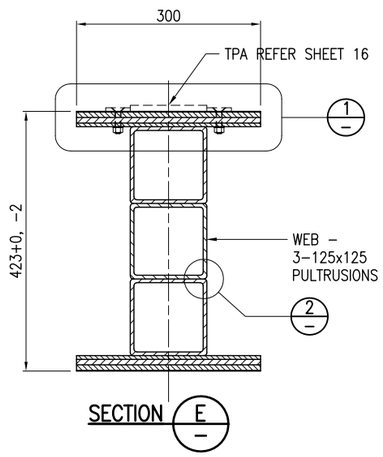
▨ – Cut length (maximum 300 at each end)



FLANGE SECTION

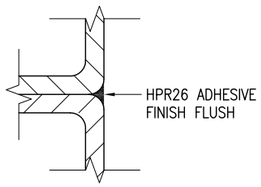


SECTION D



SECTION E

DETAIL 1



DETAIL 2

✱ Required length to be confirmed on site. FRPC girder may be cut to fit prior to installation.

✳ When trimming is required, equal length to be cut at both ends. Trimming to be in accordance with manufacturer handling/installation and maintenance guidelines. Exposed cut or cored surface to be painted with TMR approved 2 pack epoxy paint.

NOTES FOR GIRDER TYPE WCFT–S1

MATERIALS:

1. 125x125 Pultrusion wind angle 40°.
2. 87.5X62.5 Fibre composite angles cut from 125X125 Pultrusion.
3. 300x6.5 Pultrusion.
4. 150X9.5 Pultrusion.
5. 900 GSM DB
6. Resin – Derakane 8084
7. Catalyst – CHM–50

GENERAL:

Refer sheet 6 for the following:

1. Girder Performance Criteria
2. Girder Properties
3. Individual Pultrusion Material Properties

Department of Transport and Main Roads

FRP COMPOSITE GIRDERS FOR TIMBER BRIDGE REHABILITATION

WCFT–S1, S2 & S3
INSTALLATION DETAILS
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A3

Not to Scale

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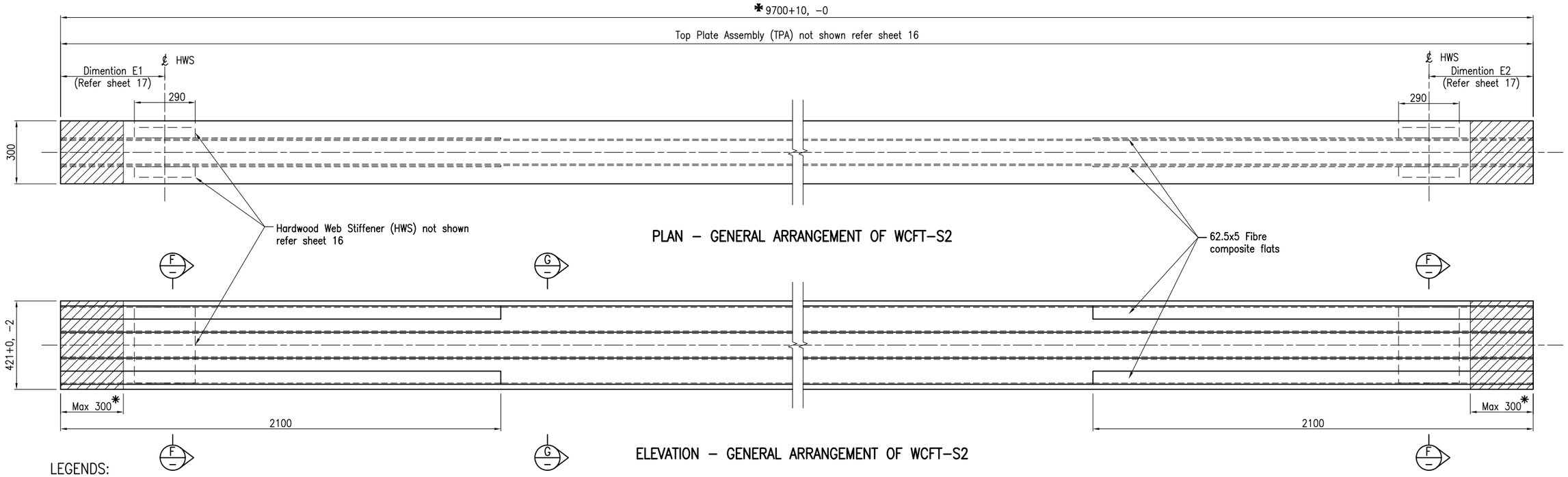
Date 7/15

A

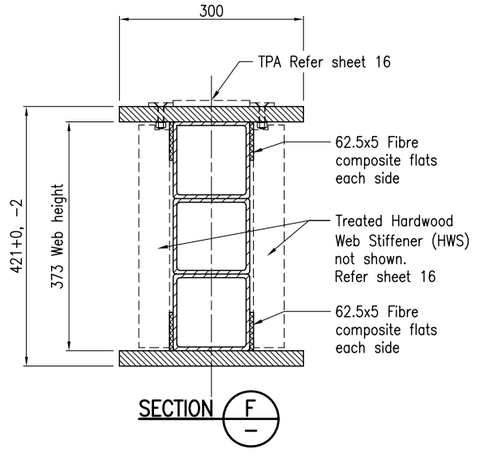


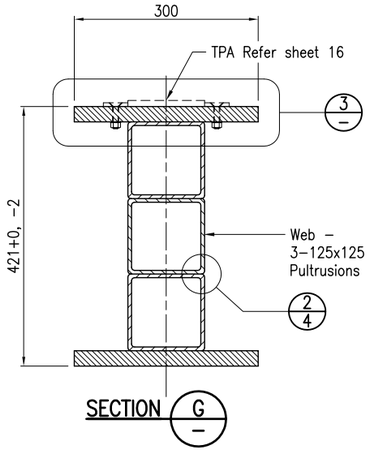
PLAN – GENERAL ARRANGEMENT OF WCFT–S2

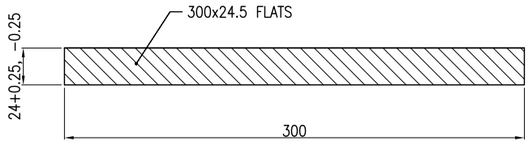
ELEVATION – GENERAL ARRANGEMENT OF WCFT–S2

LEGENDS:

▨ – Cut length (maximum 300 at each end)







FLANGE SECTION

DETAIL 3

✱ Required length to be confirmed on site. FRPC girder may be cut to fit prior to installation.

✳ When trimming is required, equal length to be cut at both ends. Trimming to be in accordance with manufacturer handling/installation and maintenance guidelines. Exposed cut or cored surface to be painted with TMR approved 2 pack epoxy paint.

NOTES FOR GIRDER TYPE WCFT–S2

MATERIALS:

1. 125x125 Pultrusion wind angle 40°.
2. 300x24.5 Pultrusion including 900GSM double bias layer on one face only.
3. 62.5x5 Pultrusion
4. Resin – Derakane 8084
5. Catalyst – CHM–50

GENERAL:

Refer sheet 6 for the following:

1. Girder Performance Criteria
2. Girder Properties
3. Individual Pultrusion Material Properties

Department of Transport and Main Roads

FRP COMPOSITE GIRDERS FOR TIMBER BRIDGE REHABILITATION

WCFT–S1, S2 & S3 INSTALLATION DETAILS SHEET 5 of 17

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A3

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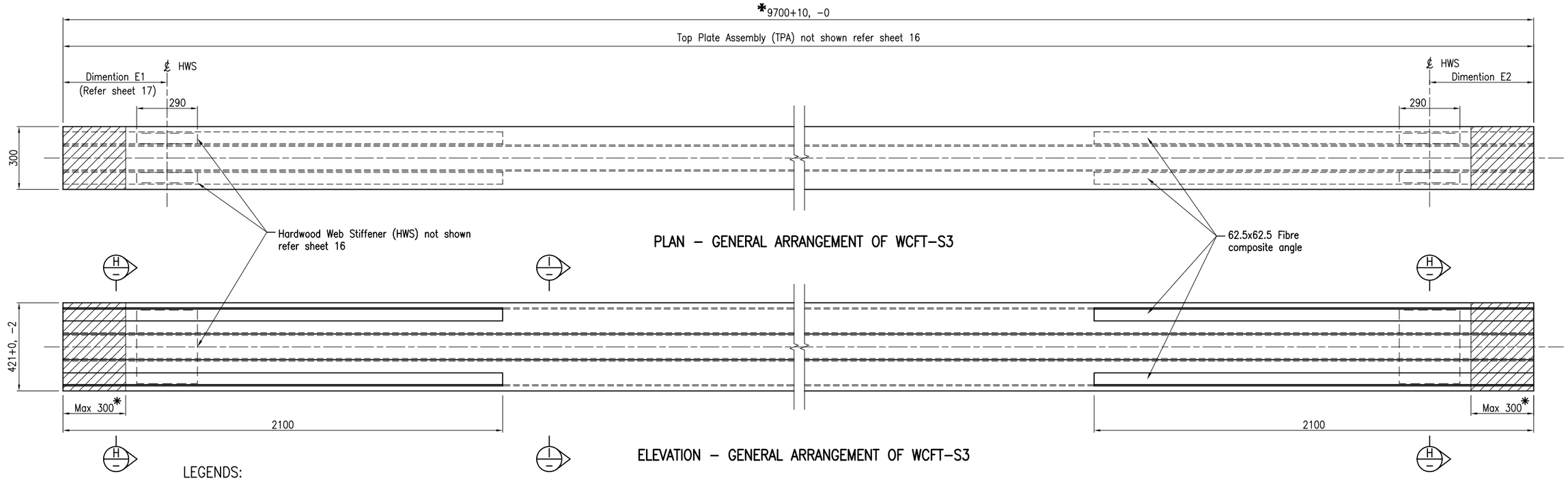
Standard Drawing No 2285

Date 7/15

A

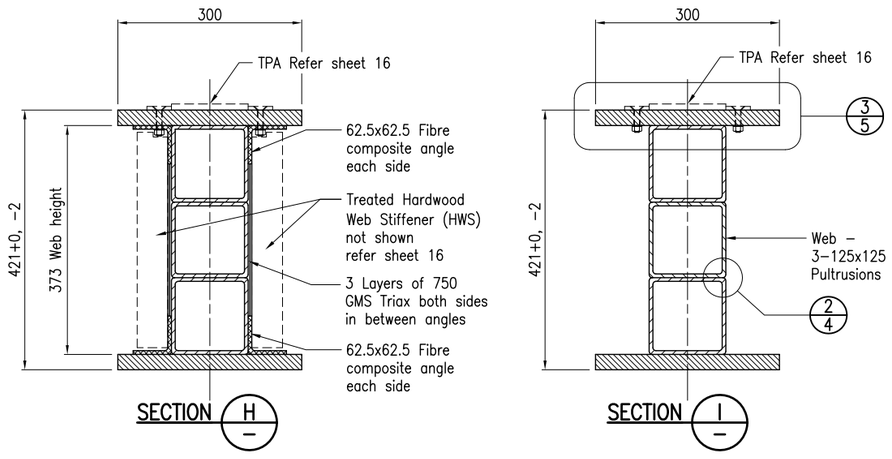


PLAN – GENERAL ARRANGEMENT OF WCFT–S3

ELEVATION – GENERAL ARRANGEMENT OF WCFT–S3

LEGENDS:

▨ – Cut length (maximum 300 at each end)



✱ Required length to be confirmed on site. FRPC girder may be cut to fit prior to installation.

✱ When trimming is required, equal length to be cut at both ends. Trimming to be in accordance with manufacturer handling/installation and maintenance guidelines. Exposed cut or cored surface to be painted with TMR approved 2 pack epoxy pai'nt.

GIRDER PERFORMANCE CRITERIA

CRITERIA	VALUE	UNITS
Maximum Width	350	mm
Maximum Depth	425	mm
M_{min} at failure (Test to destruction)	660	kNm
–ve M capacity	30% +ve BM	kNm
V_{min} at failure	350	kN
δ_{max} deflection at failure	170	mm
EI girder	2.96e13	Nmm^2
Fatigue Load Testing (1×10^6 cycles, spike load every 2×10^5 cycles)	60 210	kN cycle load kN spike load

WCFT 423x300x125BIF GIRDER PROPERTIES

PROPERTY	VALUE
Ag	$23.017 \times 10^3 mm^2$
Ix	$683.606 \times 10^6 mm^4$
Iy	$128.023 \times 10^6 mm^4$
J	$50.6985 \times 10^6 mm^4$
Iw	$4.06466 \times 10^{12} N.mm^2$
EIx	$31.8 \times 10^{12} N.mm^2$
EIx.ST	$30.339 \times 10^{12} N.mm^2$
EIx.LT	$27.305 \times 10^{12} N.mm^2$ (=0.9EIx.ST)
Ex.ST	$44.381 \times 10^3 MPa$
Ex.LT	$39.943 \times 10^3 MPa$ (=0.9Ex.ST)
Ely	$5.6876 \times 10^{12} N.mm$
Ey	$44.426 \times 10^3 MPa$

NOTES FOR GIRDER TYPE WCFT–S3

MATERIALS:

1. 125x125 Pultrusion wind angle 40°.
2. 300x24.5 Pultrusion including 900GSM double bias layer on one face only.
3. 62.5x62.5 Fibre composite angle cut from 125x125 Pultrusion
4. Resin – Derakane 8084
5. Catalyst – CHM–50

GENERAL:

Refer tables for:

1. Girder Performance Criteria
2. Girder Properties
3. Individual Pultrusion Material Properties

Department of Transport and Main Roads

FRP COMPOSITE GIRDERS FOR TIMBER BRIDGE REHABILITATION

WCFT–S1, S2 & S3
INSTALLATION DETAILS
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A3
Not to Scale
A

Standard Drawing No
2285
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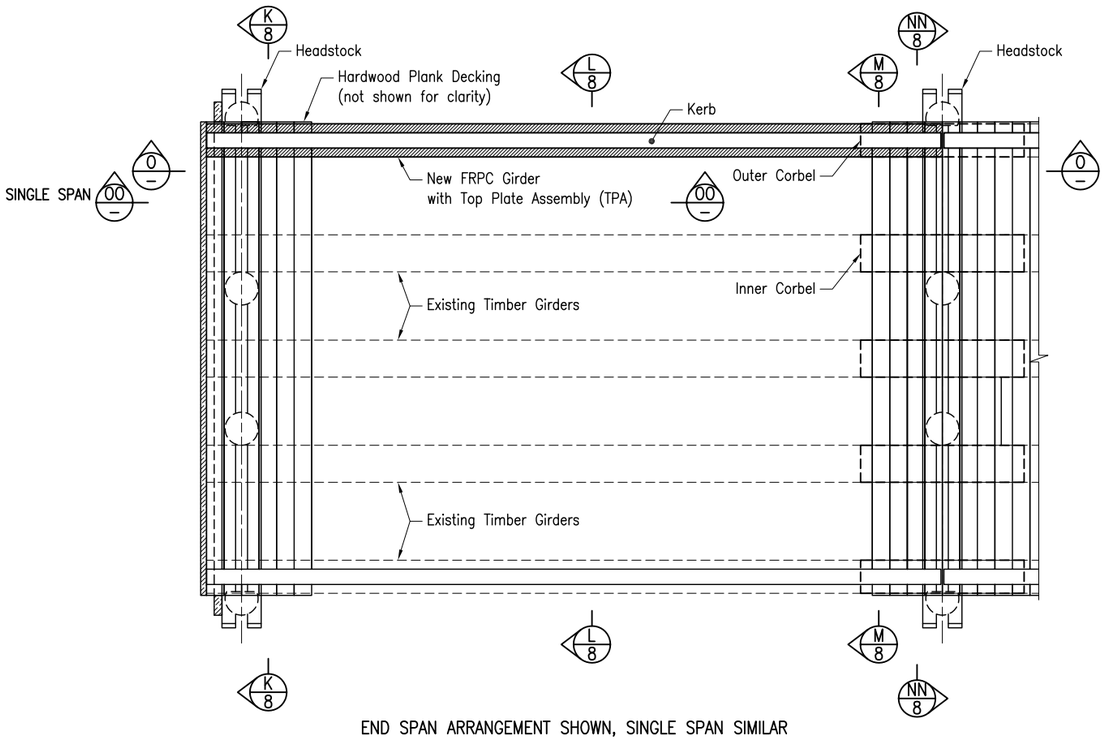
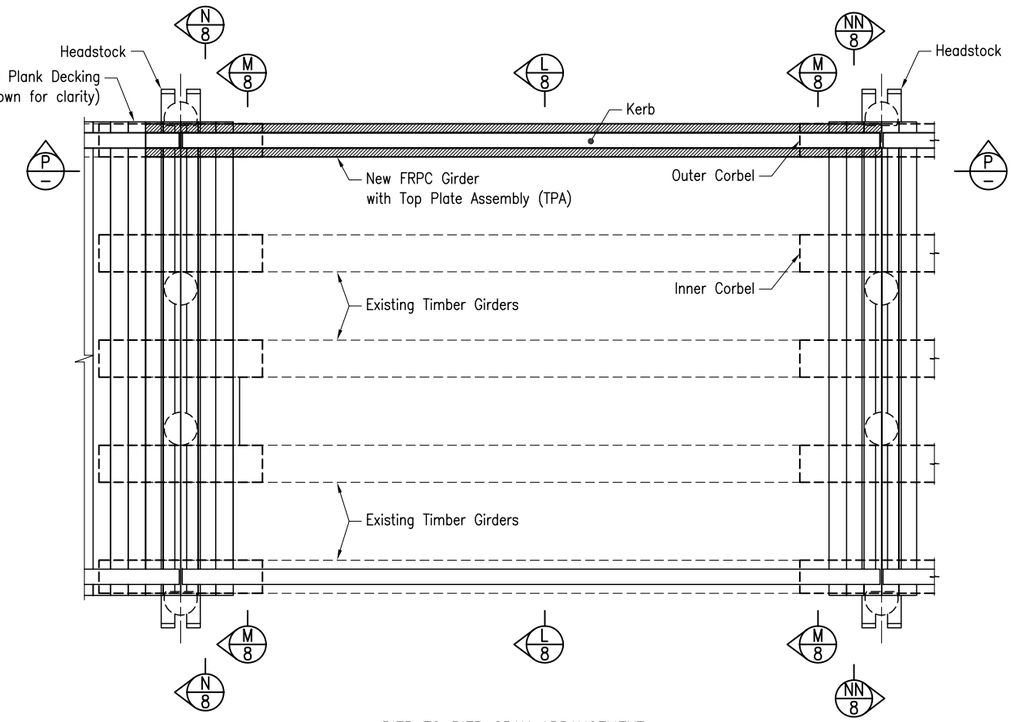
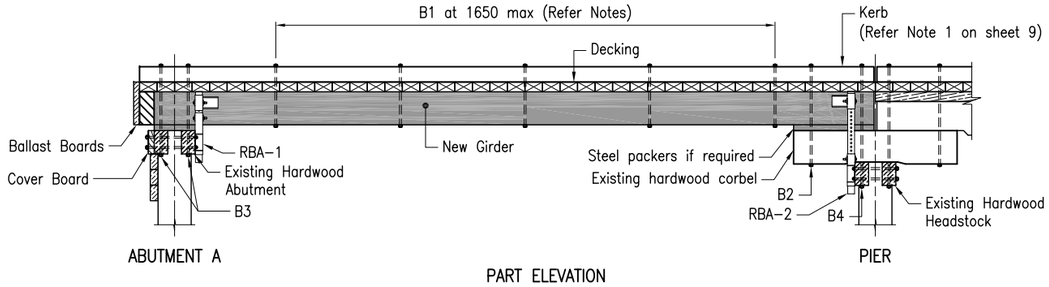


END SPAN ARRANGEMENT SHOWN, SINGLE SPAN SIMILAR



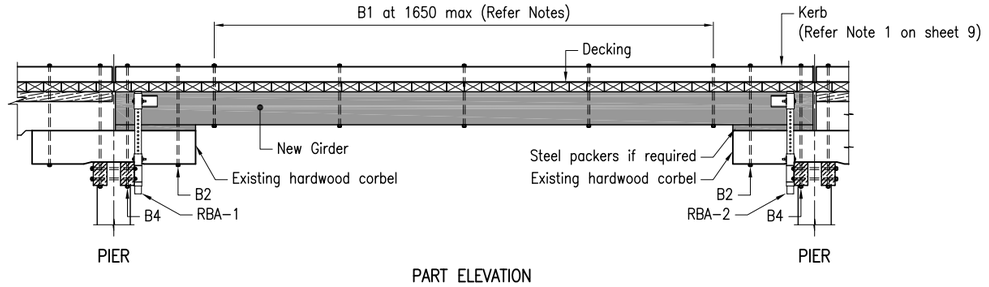
PIER TO PIER SPAN ARRANGEMENT

PLAN – GENERAL ARRANGEMENT EXTERNAL GIRDER REPLACEMENT



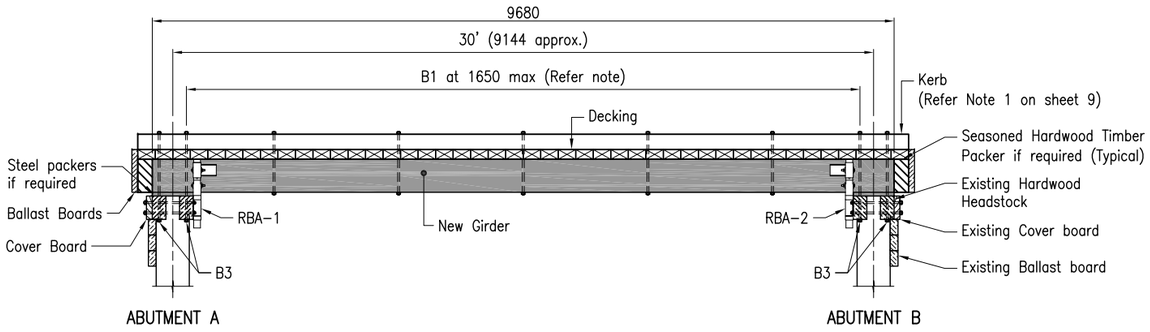
PART ELEVATION

SECTION 0/– END SPAN (MULTISPAN BRIDGE)



PART ELEVATION

SECTION P/– INTERIOR SPAN (MULTISPAN BRIDGE)



PART ELEVATION

SECTION 00/– SINGLE SPAN

NOTES:

1. Bolt spacing and locations to match existing spacing in kerb where applicable.
2. The top of all bolt holes to be sealed with approved sealant. Refer Detail 14 on sheet 9.

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FRP COMPOSITE GIRDERS
FOR TIMBER BRIDGE REHABILITATION

WCFT–S1, S2 & S3
INSTALLATION DETAILS
SHEET 7 of 17

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A3
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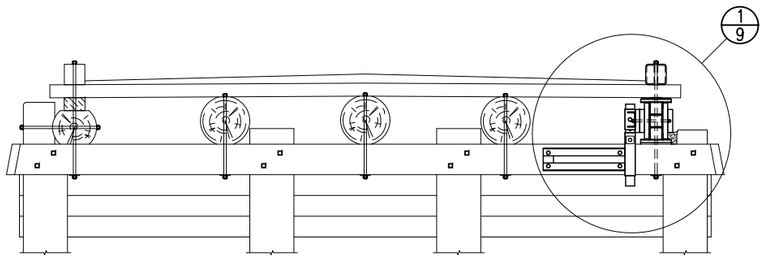
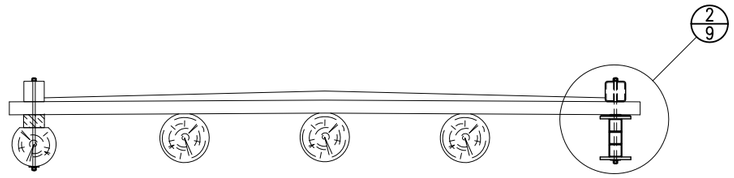
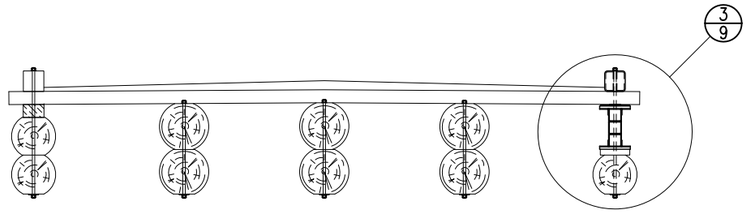


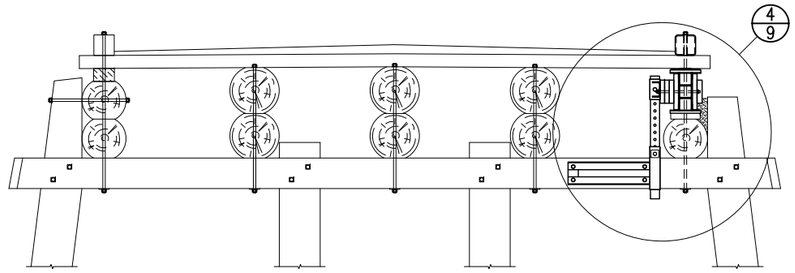
SECTION K 7



SECTION L 7



SECTION M 7



SECTION N 7

SECTION NN 7 SIMILAR (OPPOSITE HAND)

NOTES:
1. Refer sheet 7 for indicative bolt layout.

Department of Transport and Main Roads

FRP COMPOSITE GIRDERS FOR TIMBER BRIDGE REHABILITATION

WCFT–S1, S2 & S3
INSTALLATION DETAILS
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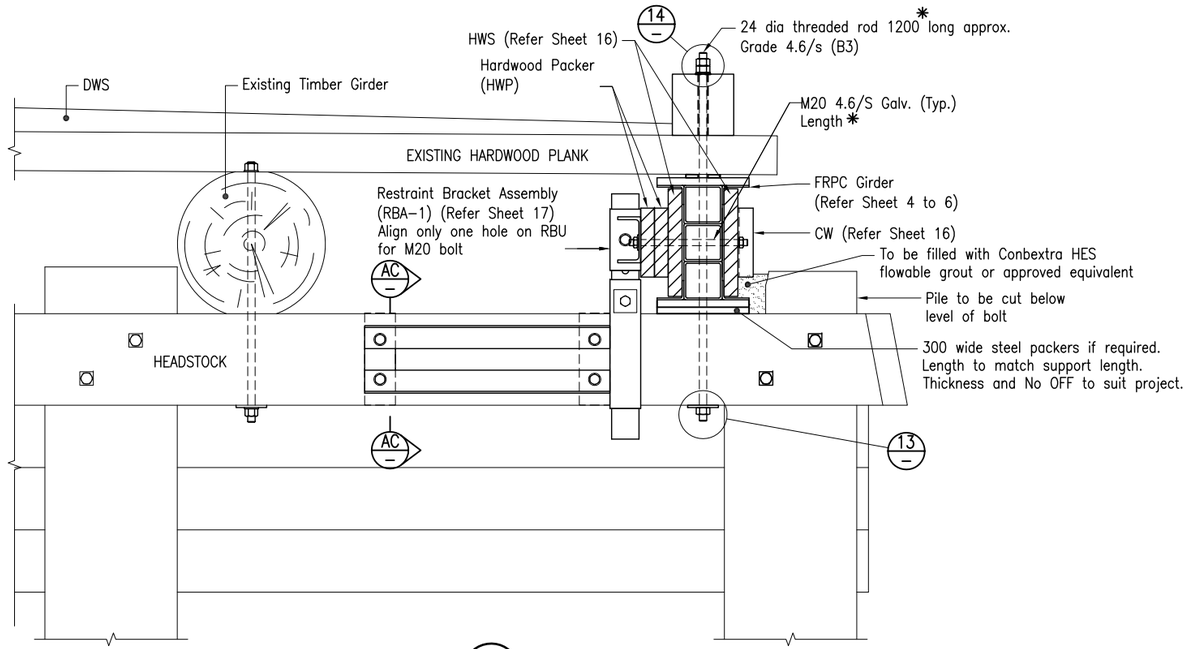
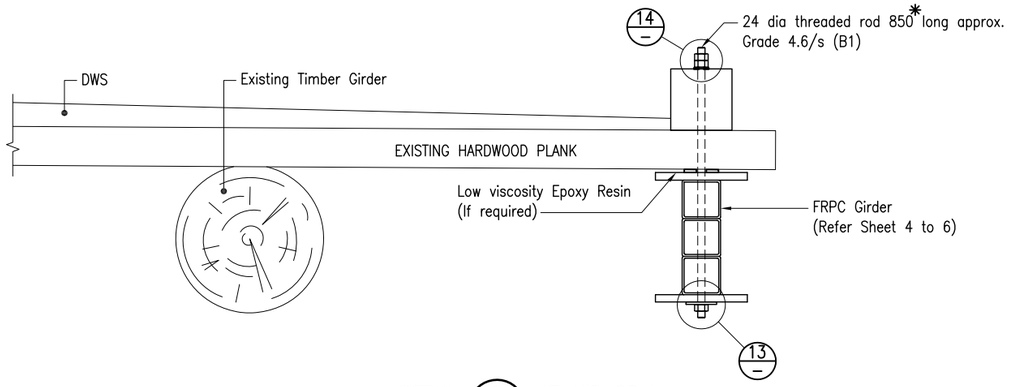
A3
Not to Scale
A

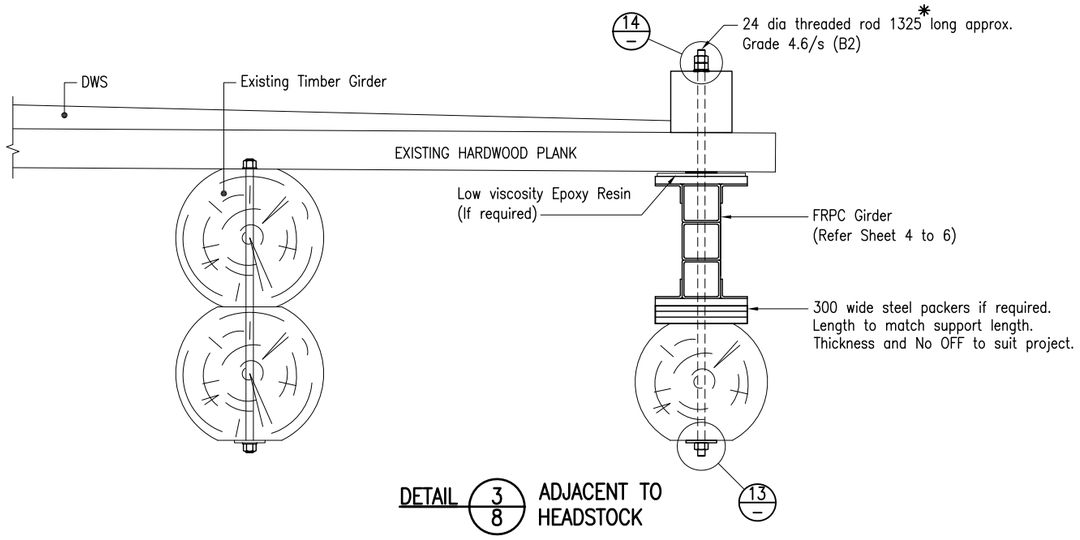
Standard Drawing No
2285
Date 7/15



DETAIL 1/8 AT ABUTMENT

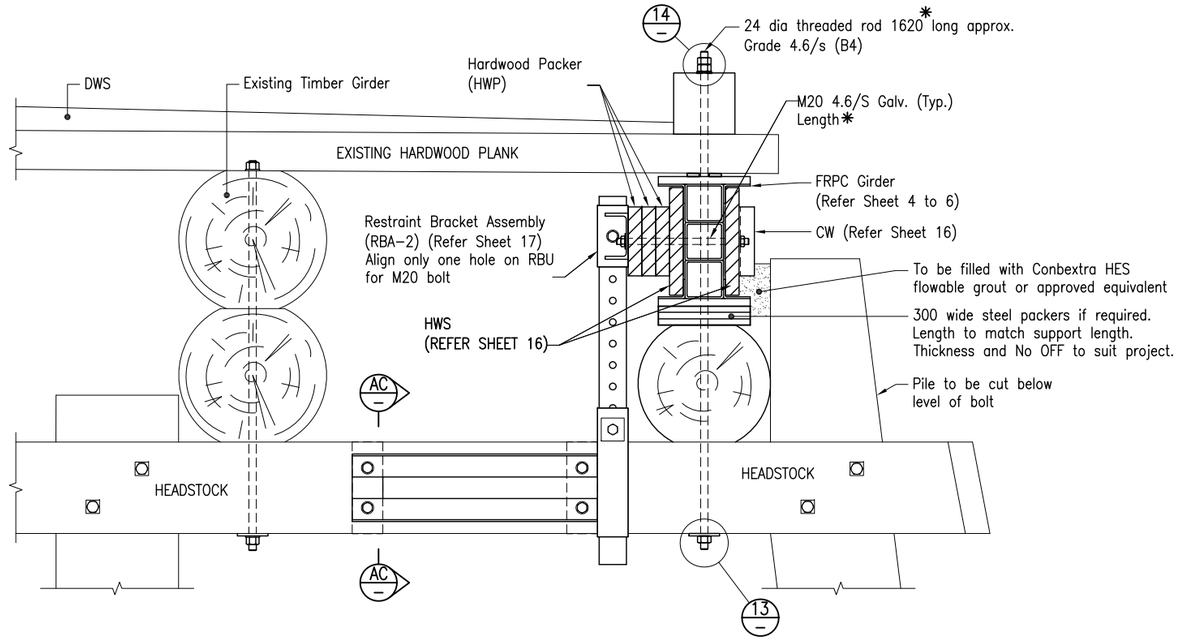


DETAIL 2/8 AT MID SPAN

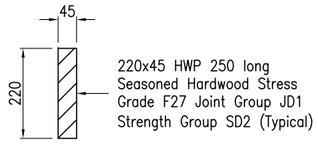


DETAIL 3/8 ADJACENT TO HEADSTOCK

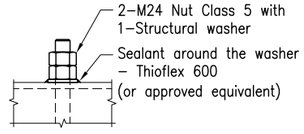
✱ Dimensions to be confirmed on site



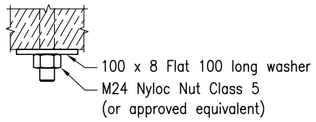
DETAIL 4/8 AT PIER



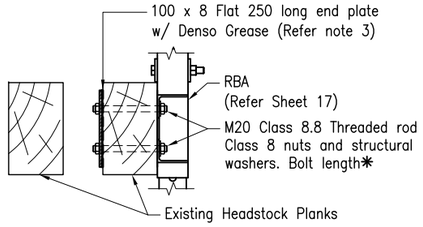
TIMBER PACKER (HWP) DETAIL



DETAIL 14



DETAIL 13



SECTION AC

NOTES:

1. Existing kerb conditions must be inspected during any girder replacement procedure to determine if existing kerb may be reused or replaced.
2. All Structural Steelwork to be Hot Dip Galvanised.
3. Denso Grease or equivalent to be applied to headstock area which will be in contact with remaining bracket.
4. Hardwood to be treated in accordance with Timber Bridge Maintenance Manual.
5. Grade 8.8 threaded rod may be used in lieu of grade 4.6.
6. Bolts conforming with MRTS78 may be used in lieu in of threaded rod.

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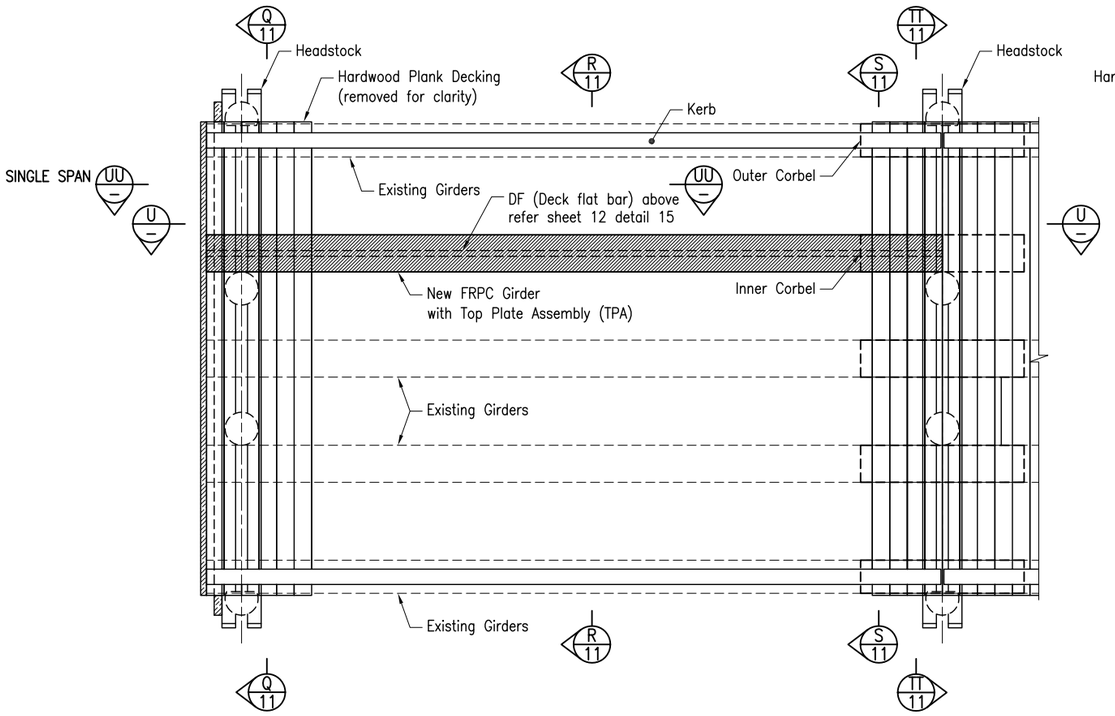
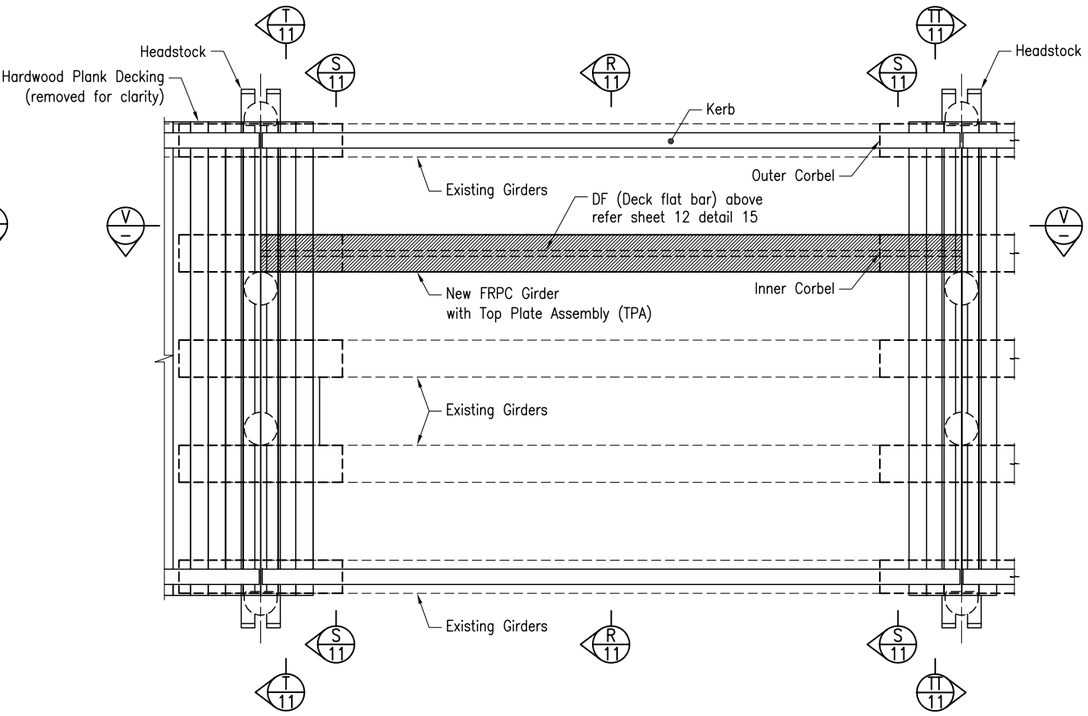
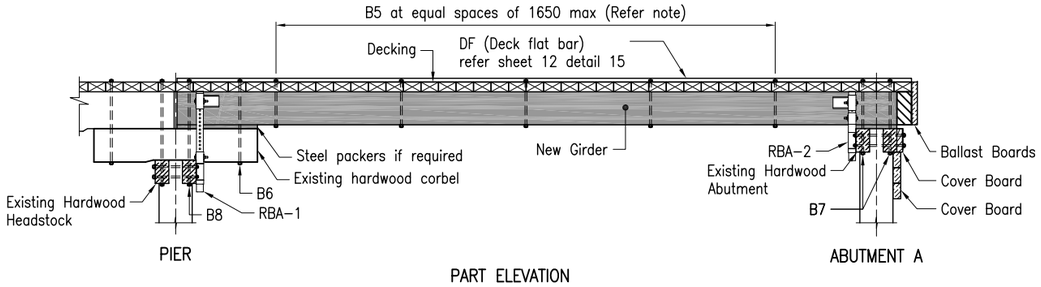


END SPAN ARRANGEMENT SHOWN, SINGLE SPAN SIMILAR



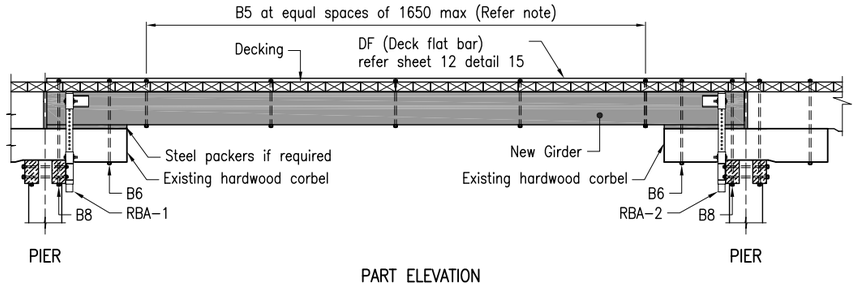
PIER TO PIER SPAN ARRANGEMENT

PLAN – GENERAL ARRANGEMENT INTERMEDIATE GIRDER REPLACEMENT



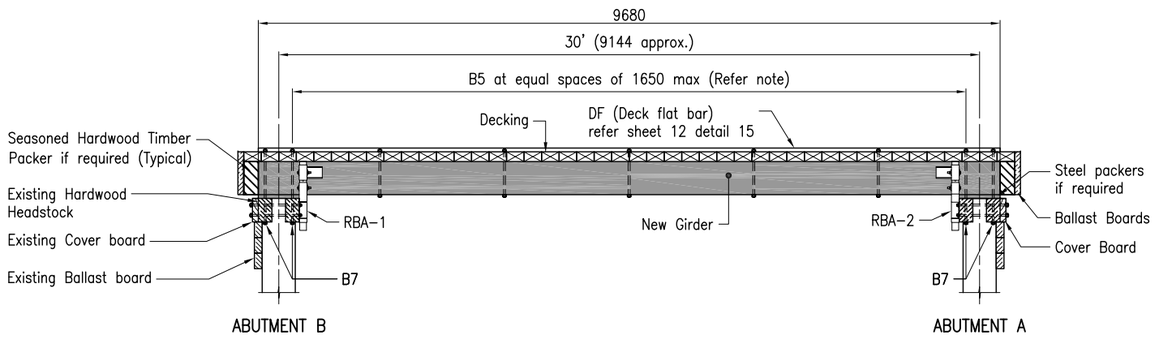
PART ELEVATION

SECTION U – END SPAN (MULTISPAN BRIDGE)



PART ELEVATION

SECTION V – INTERIOR SPAN (MULTISPAN BRIDGE)



PART ELEVATION

SECTION UU – SINGLE SPAN

NOTES:

1. Bolt spacing and locations to match existing where applicable.
2. The top of all bolt holes to be sealed with approved sealant. Refer Detail 14 on sheet 9.

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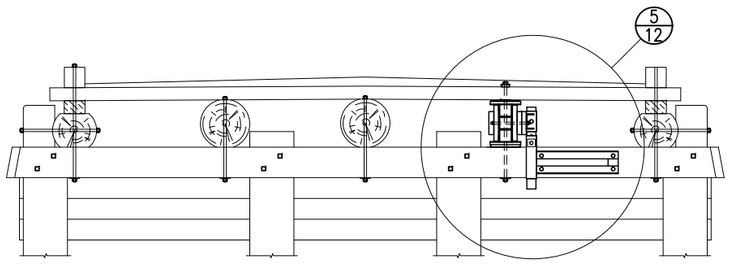
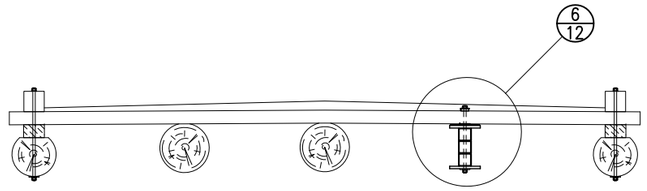
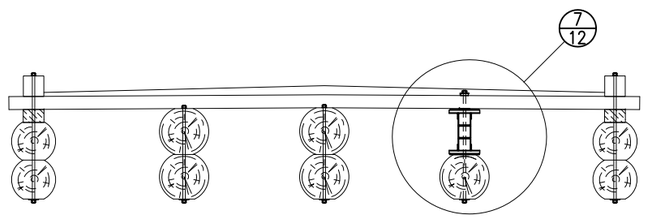


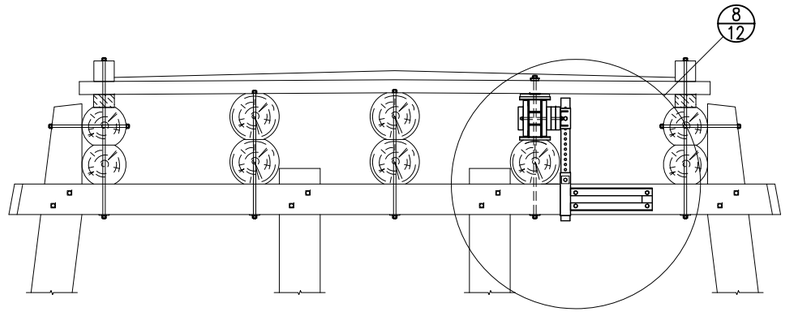
SECTION Q 10



SECTION R 10



SECTION S 10



SECTION T 10

SECTION TT 10 SIMILAR (OPPOSITE HAND)

NOTES:
1. Refer sheet 10 for indicative bolt layout

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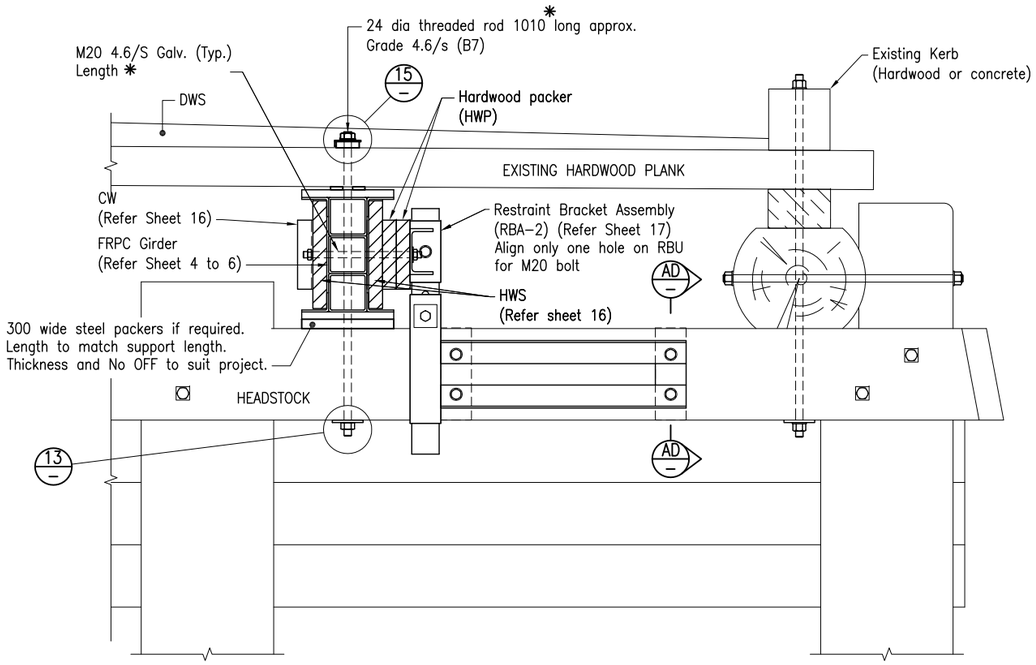
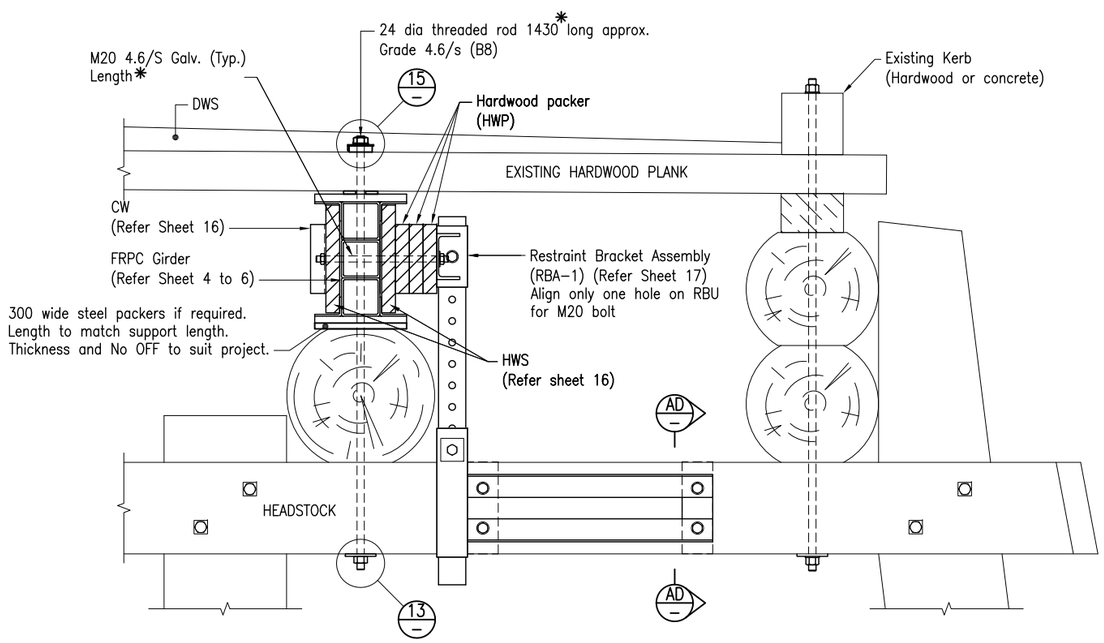
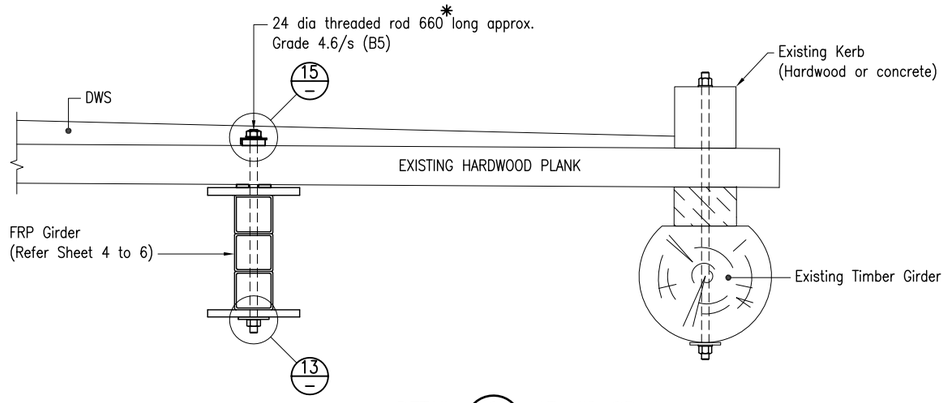


DETAIL 5/11 AT ABUTMENT

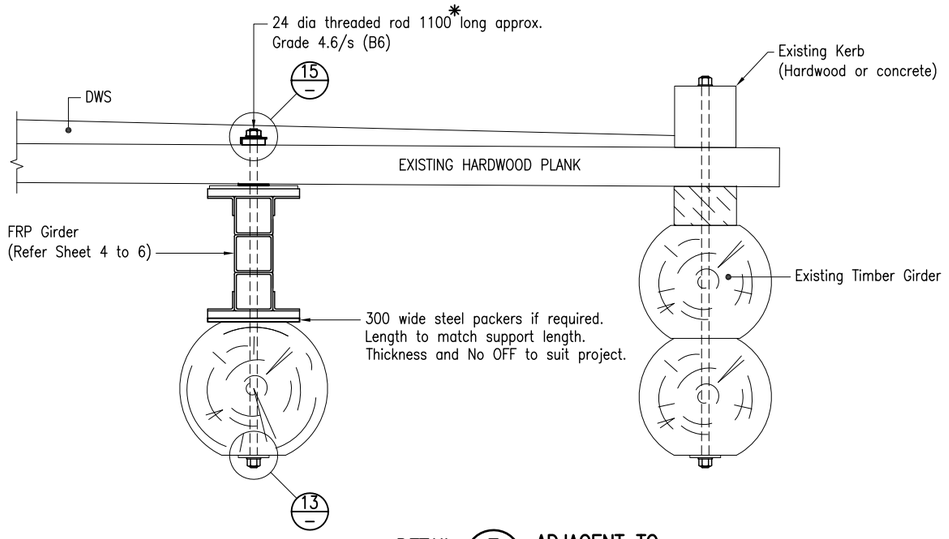
*Dimensions to be confirmed on site



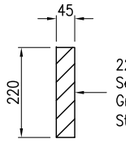
DETAIL 8/11 AT PIER



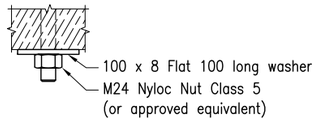
DETAIL 6/11 AT MID SPAN



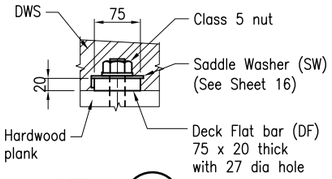
DETAIL 7/11 ADJACENT TO HEADSTOCK



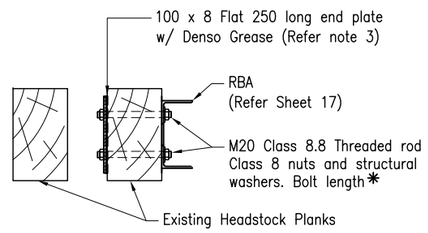
TIMBER PACKER (HWP) DETAIL



DETAIL 13/–



DETAIL 15/–



SECTION AD/–

NOTES:
1. All Structural Steelwork to be Hot Dip Galvanised.
2. Denso Grease or equivalent to be applied to headstock area which will be in contact with remaining bracket.
3. Hardwood to be treated in accordance with Timber Bridge Maintenance Manual.
4. Grade 8.8 threaded rod may be used in lieu of grade 4.6.
5. Bolts conforming with MRTS78 may be used in lieu in of threaded rod.

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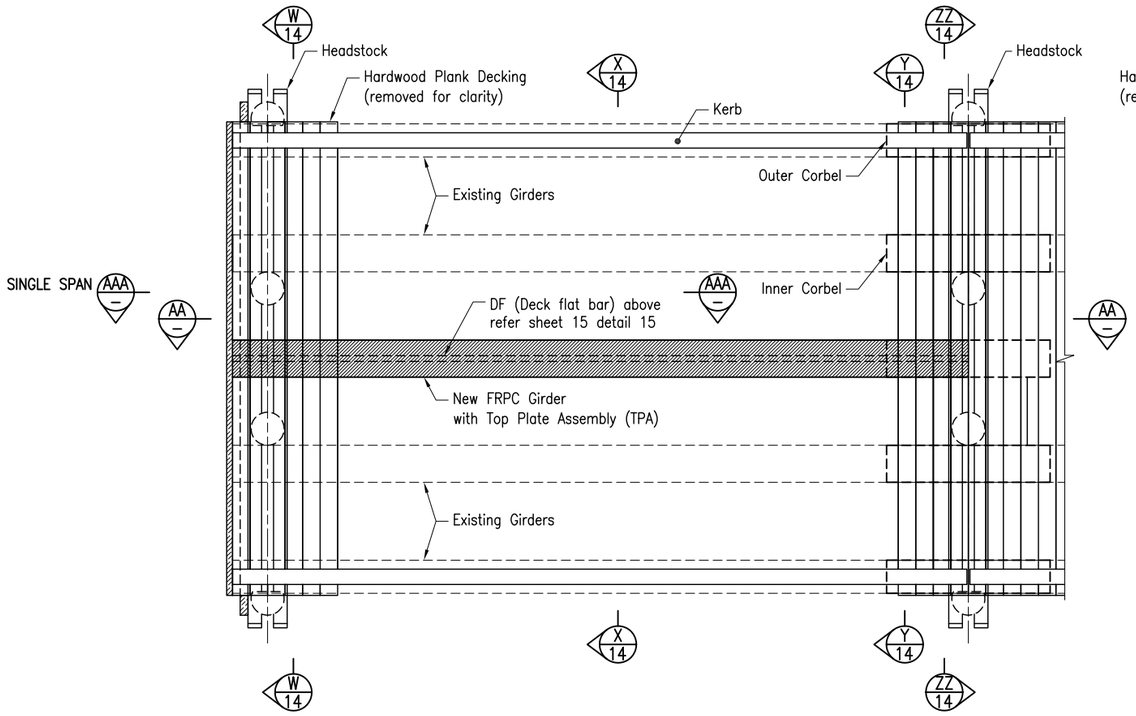
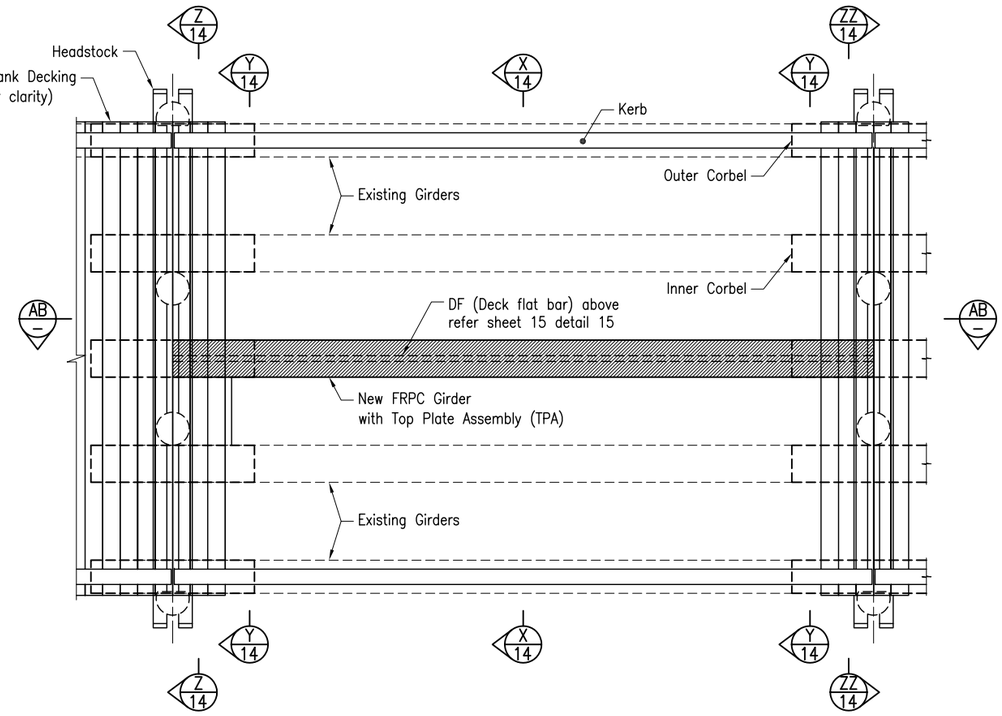
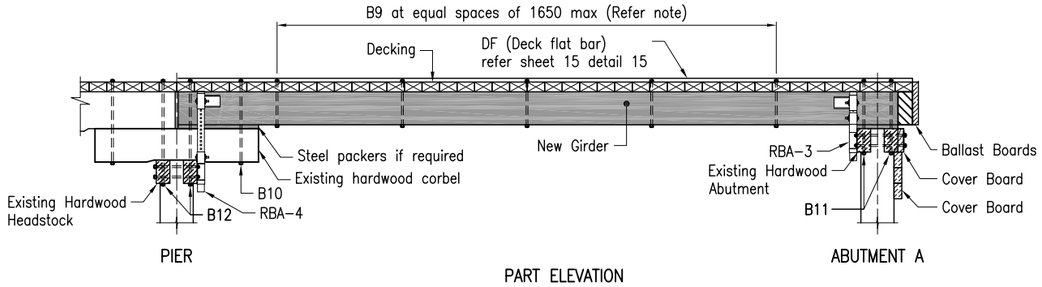


END SPAN ARRANGEMENT SHOWN, SINGLE SPAN SIMILAR



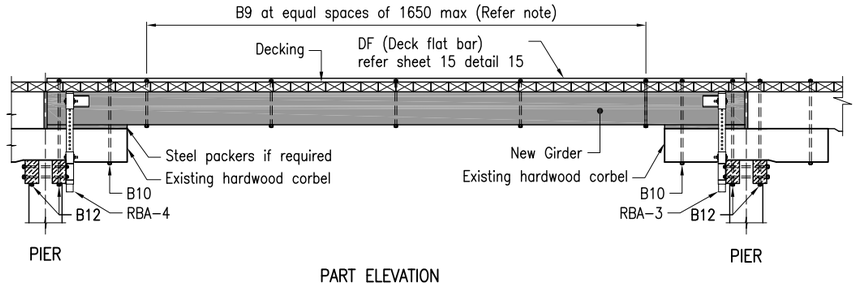
PIER TO PIER SPAN ARRANGEMENT

PLAN – GENERAL ARRANGEMENT CENTRAL GIRDER REPLACEMENT



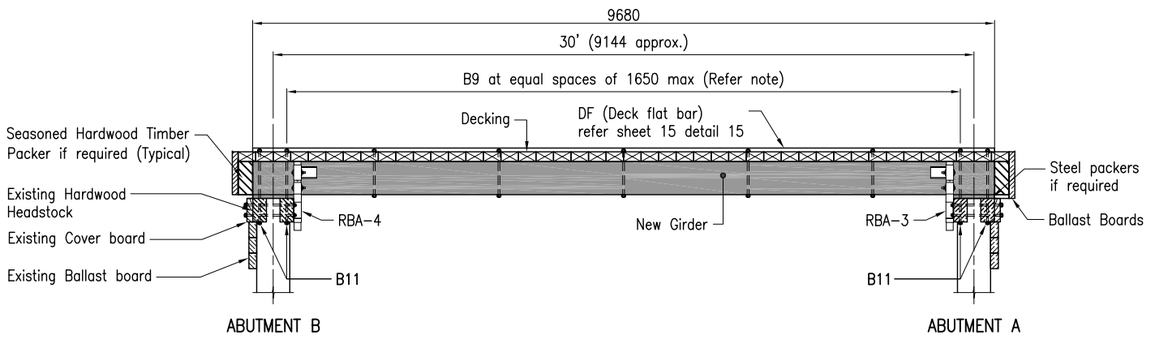
PART ELEVATION

SECTION AA – END SPAN (MULTISPAN BRIDGE)



PART ELEVATION

SECTION AB – INTERIOR SPAN (MULTISPAN BRIDGE)



PART ELEVATION

SECTION AAA – SINGLE SPAN

NOTES:

1. Bolt spacing and locations to match existing where applicable.
2. The top of all bolt holes to be sealed with approved sealant. Refer Detail 14 on sheet 9.

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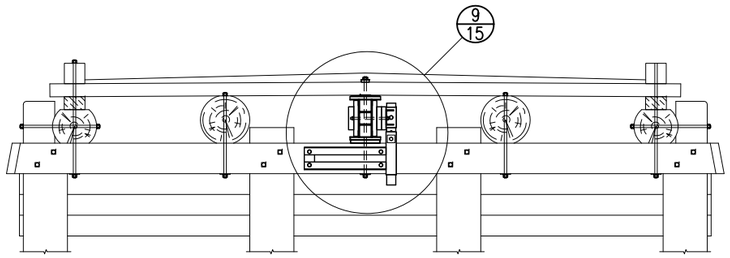
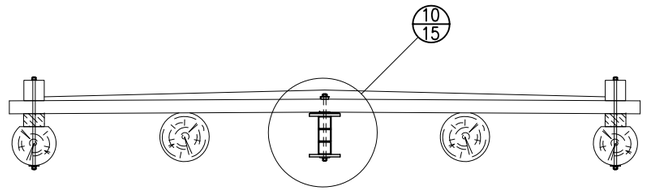
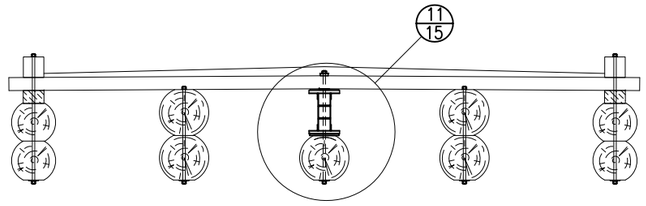


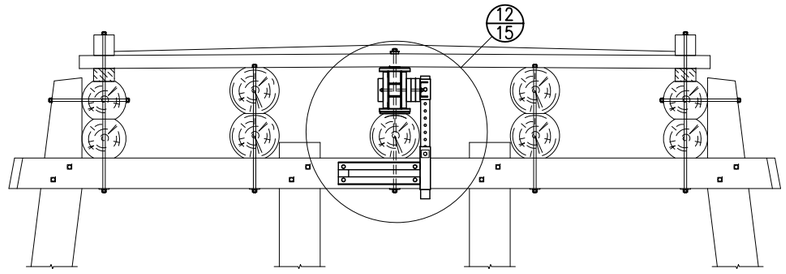
SECTION W 13



SECTION X 13



SECTION Y 13



SECTION Z 13

SECTION ZZ 13 SIMILAR (OPPOSITE HAND)

NOTES:
1. Refer sheet 13 for indicative bolt layout

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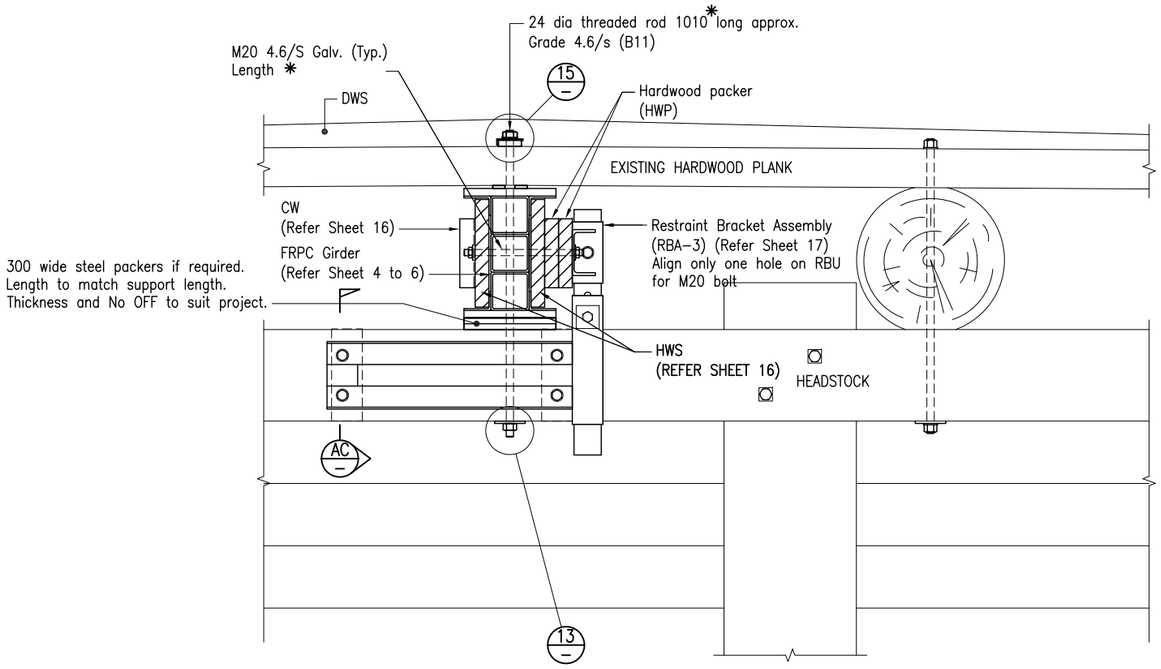
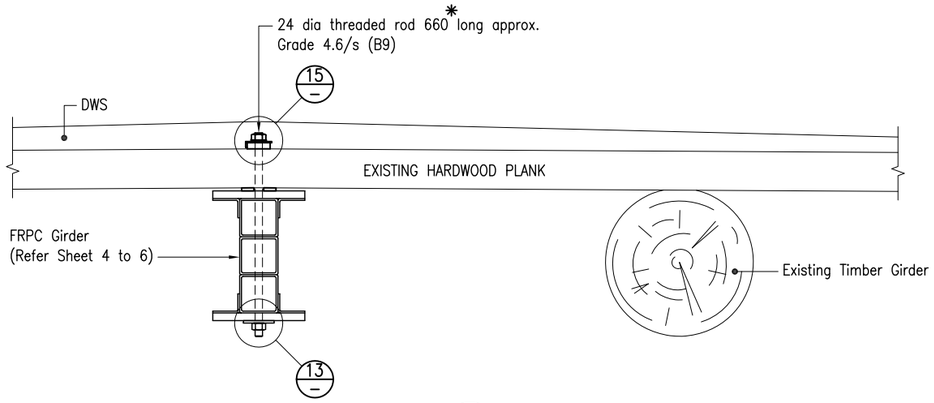
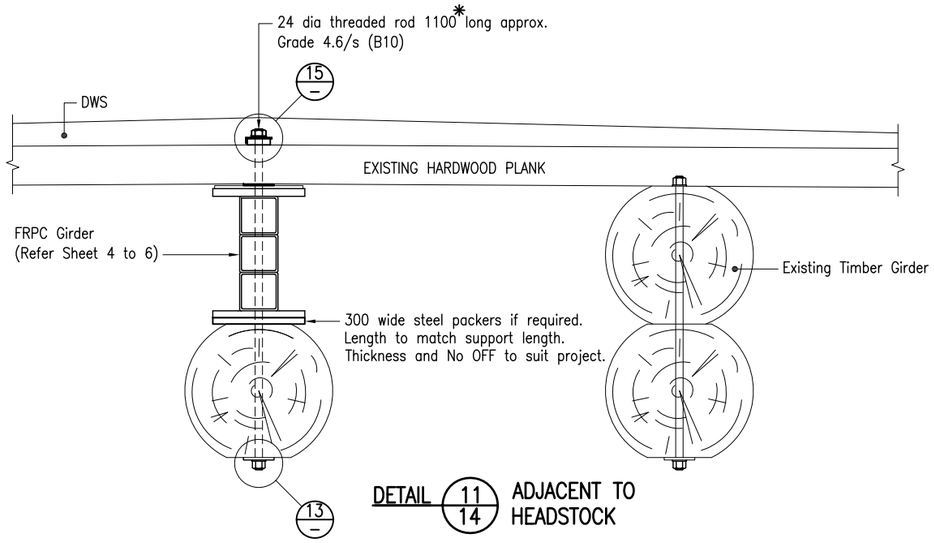


DETAIL 9/14 AT ABUTMENT

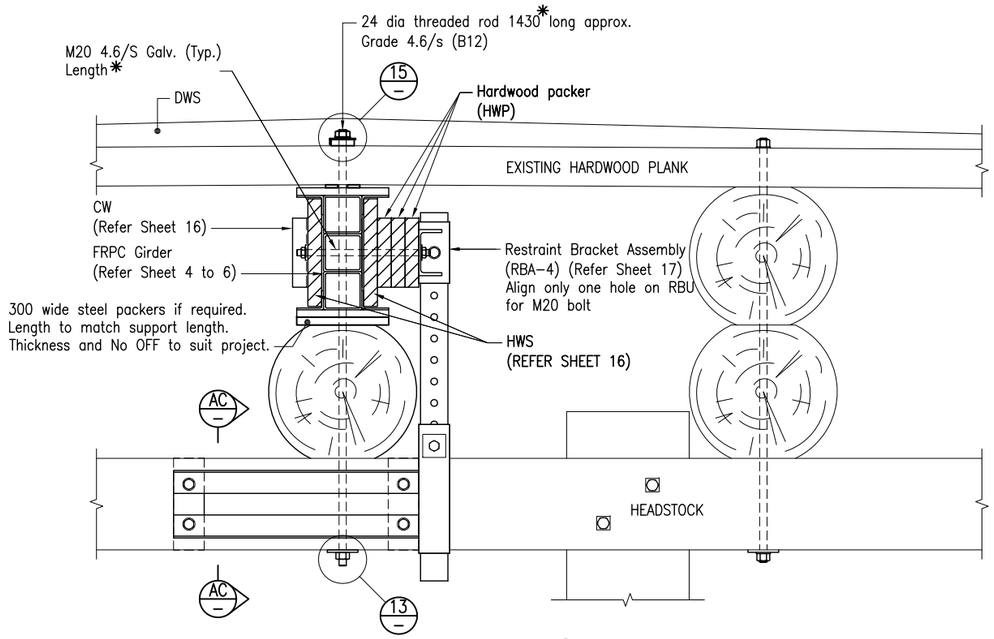


DETAIL 10/14 AT MID SPAN

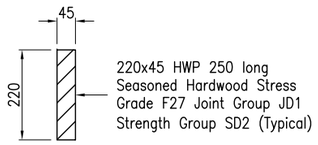


DETAIL 11/14 ADJACENT TO HEADSTOCK

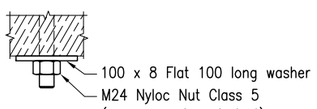
*Dimensions to be confirmed on site



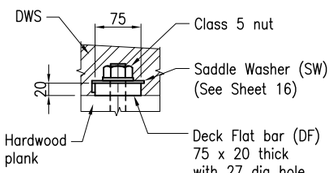
DETAIL 12/14 AT PIER



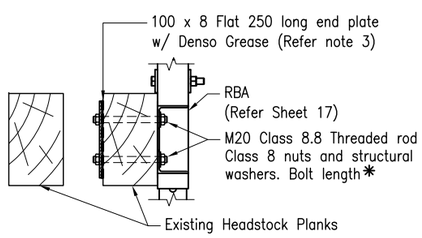
TIMBER PACKER (HWP) DETAIL



DETAIL 13



DETAIL 15



SECTION AC

NOTES:

1. All Structural Steelwork to be Hot Dip Galvanised.
2. Denso Grease or equivalent to be applied to headstock area which will be in contact with remaining bracket.
3. Hardwood to be treated in accordance with Timber Bridge Maintenance Manual.
4. Grade 8.8 threaded rod may be used in lieu of grade 4.6.
5. Bolts conforming with MRTS78 may be used in lieu in of threaded rod.

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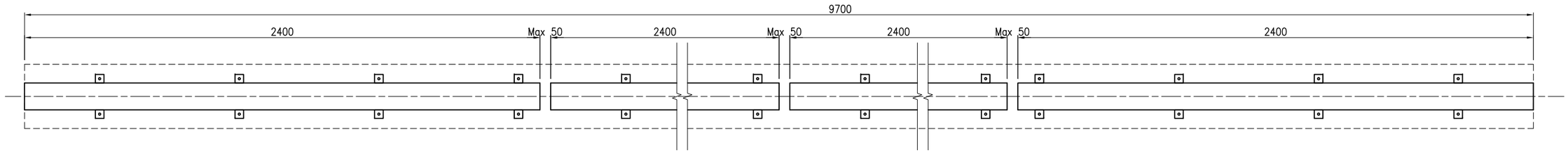
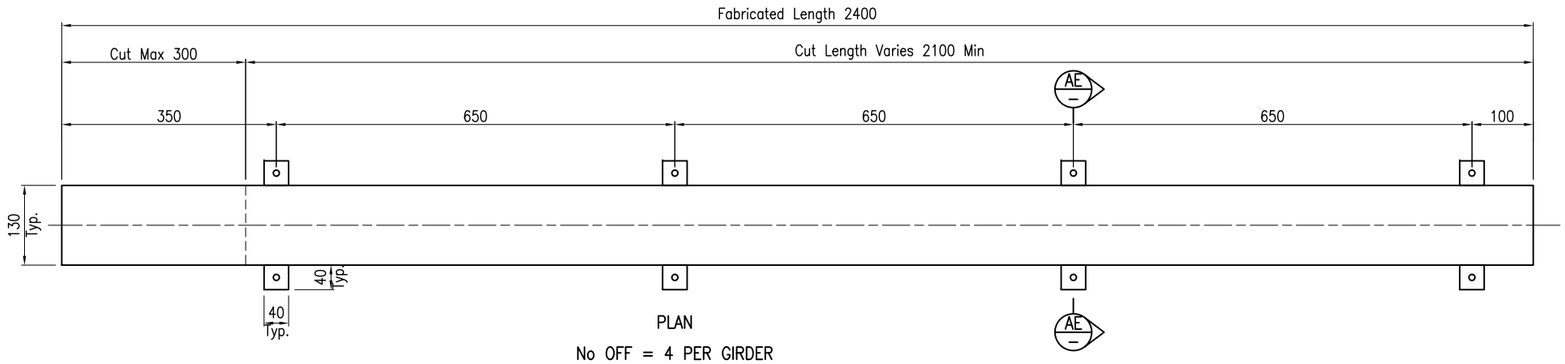


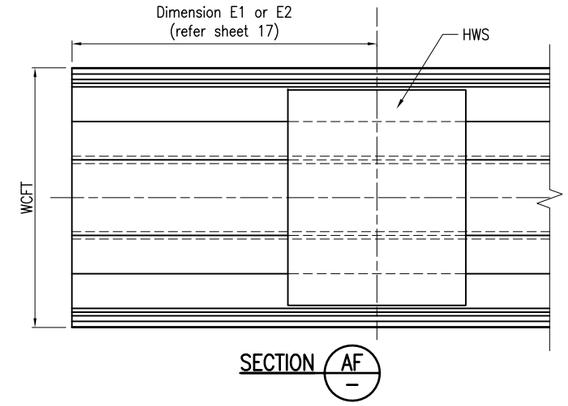
PLAN – TOP PLATE ASSEMBLY (TPA)



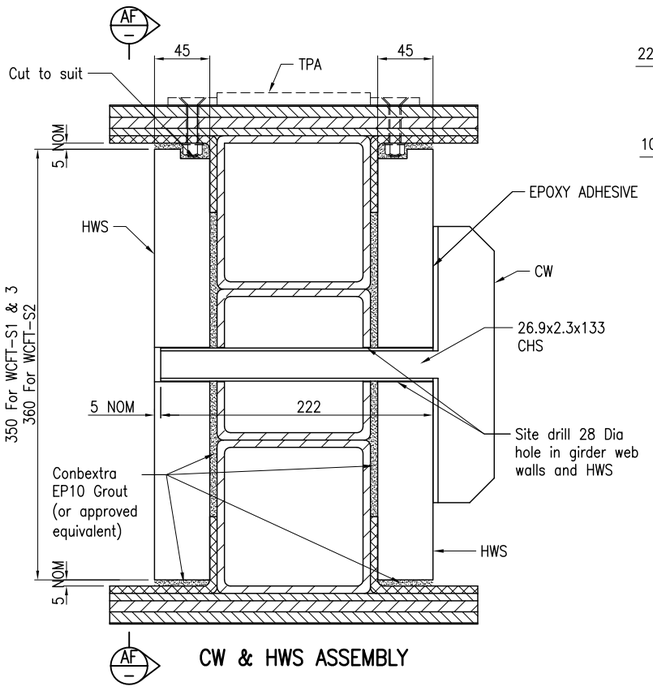
PLAN

No OFF = 4 PER GIRDER

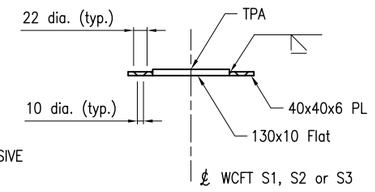
PLAN – TOP PLATE DETAIL



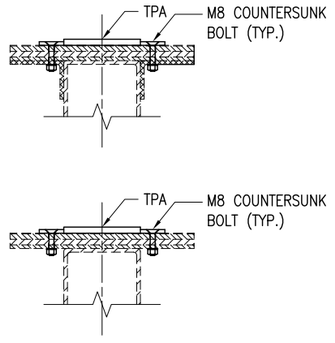
SECTION AF



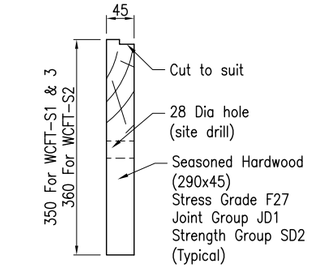
CW & HWS ASSEMBLY



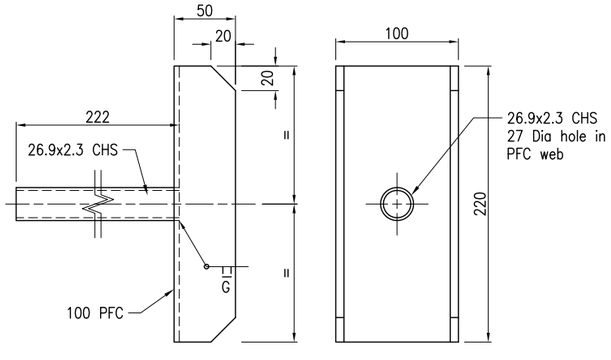
SECTION AE



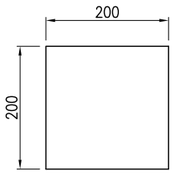
SECTION – TOP PLATE DETAIL



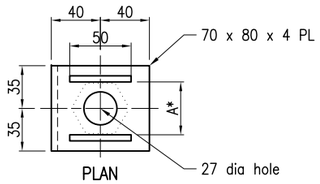
HARDWOOD WEB STIFFENER (HWS) DETAIL



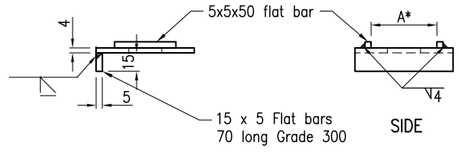
CHANNEL WEB STIFFENER (CW) DETAIL



JACKING PLATE (JP) DETAIL
(200 x 10 Flat x 200 long)

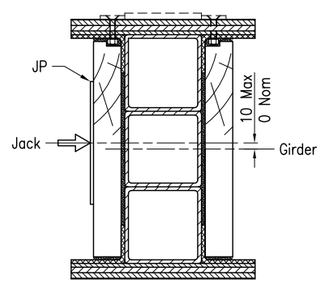


PLAN



A* = 43mm FOR GRADE 8.8 BOLT
A* = 40mm FOR GRADE 4.6 BOLT

SADDLE WASHER (SW) DETAIL



JACKING POSITION

Department of Transport and Main Roads

FRP COMPOSITE GIRDERS
FOR TIMBER BRIDGE REHABILITATION

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A

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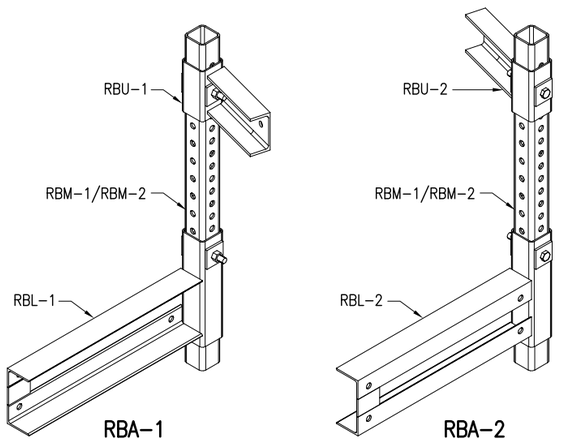
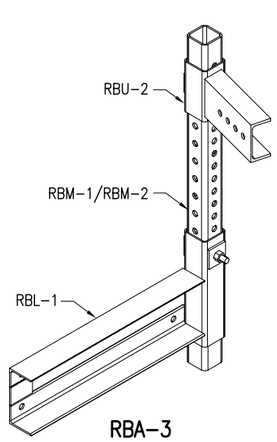


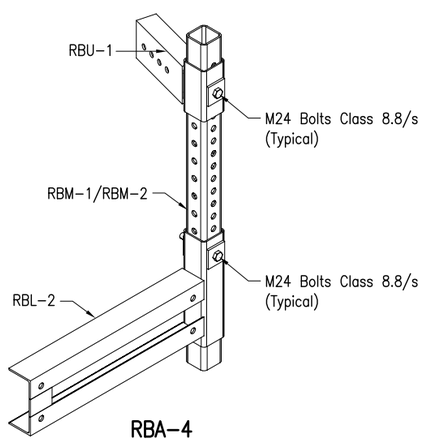
RBA–1

RBA–2

EXTERNAL/INTERMEDIATE GIRDER REPLACEMENT

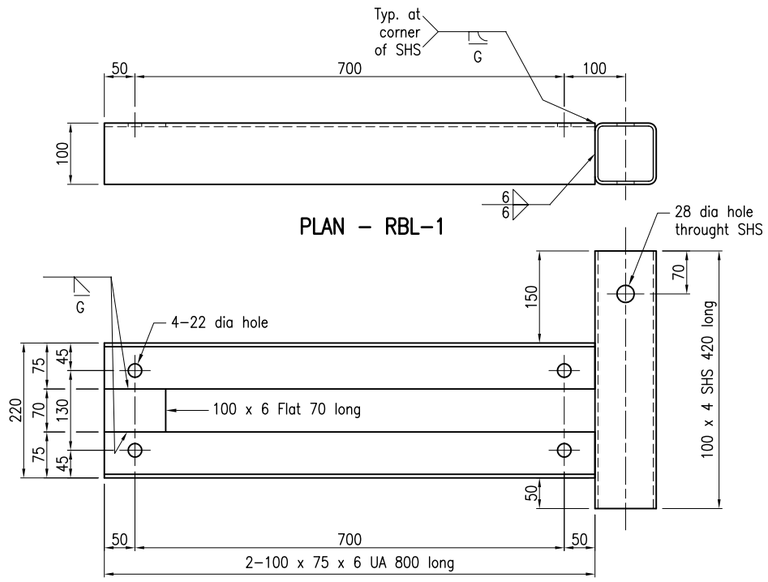


RBA–3

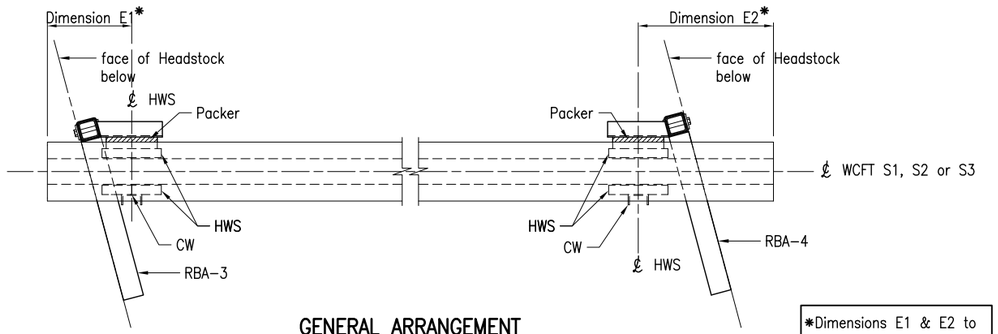


RBA–4

CENTRAL GIRDER REPLACEMENT

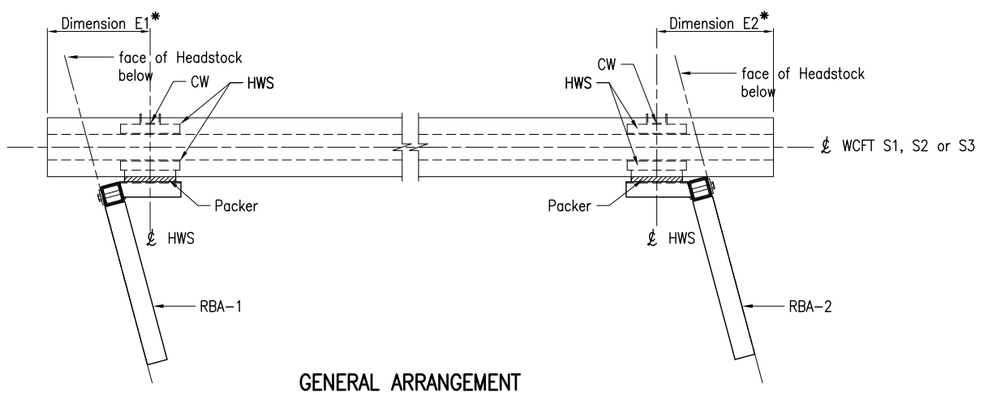


ELEATION – RBL–1
RBL–2 SIMILAR OPPOSITE HAND

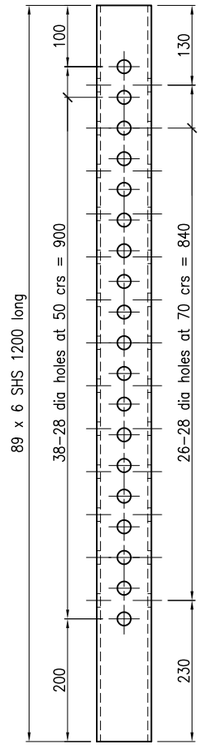


GENERAL ARRANGEMENT
CENTRAL GIRDER RESTRAINTS

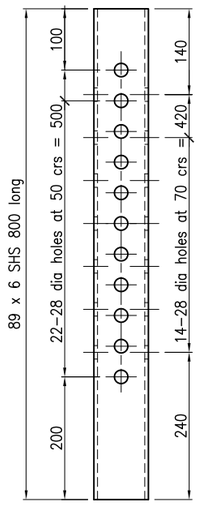
*Dimensions E1 & E2 to be determined on site. Refer SD 2286 sheet 2 for installation procedure



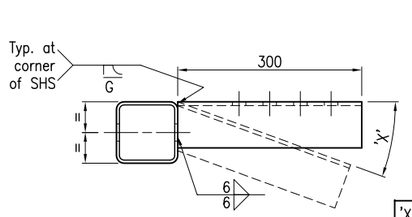
GENERAL ARRANGEMENT
EXTERNAL/INTERMEDIATE GIRDER RESTRAINTS



ELEVATION – RBM–1
(FOR USE AT PIER)

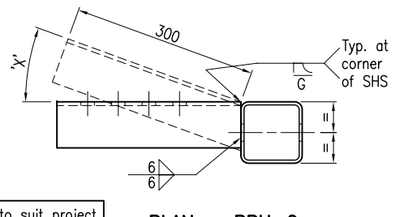


ELEVATION – RBM–2
(FOR USE AT ABUTMENT)

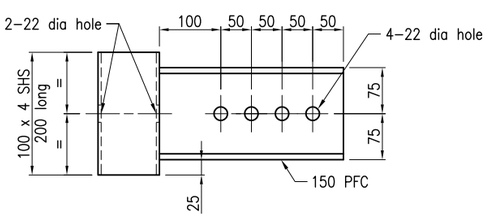


PLAN – RBU–1

'X' to suit project specific skew



PLAN – RBU–2



ELEVATION – RBU–1
RBU–2 SIMILAR OPPOSITE HAND

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