

Technical Specification

**Transport and Main Roads Specification
MRTS60 Installation of Fibre Reinforced Polymer (FRP)
Composite Girders**

July 2017

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1 Introduction

This Technical Specification applies to the installation of Fibre Reinforced Polymer (FRP) composite girders. The FRP girders are intended for two different applications:

- to replace timber girders in an existing timber bridge, and
- to use as superstructure in a new bridge.

This Technical Specification shall be read in conjunction with MRTS01 *Introduction to Technical Specifications*, MRTS50 *Specific Quality System Requirements* and other Technical Specifications as appropriate.

This Technical Specification forms part of the Transport and Main Roads Specifications Manual.

FRP girders shall be manufactured as per the requirements of MRTS59 *Manufacture of Fibre Reinforced Polymer (FRP) Composite Girders*.

FRP girders shall be installed by an experienced crew who have experience in bridge-related work. The FRP girders shall not be treated as hardwood timber beams.

2 Definition of terms

The terms used in this Specification shall be as defined in Clause 2 of MRTS01 *Introduction to Technical Specifications*.

3 Referenced documents

Table 3 lists documents referenced in this Technical Specification.

Table 3 – Referenced documents

Reference	Title
AS 1214	<i>Hot-dip Galvanized Coating on Threaded Fasteners (ISO Metric Coarse Thread Series)</i>
AS/NZS 4680	<i>Hot-dip Galvanized (zinc) Coatings on Fabricated Ferrous Articles</i>
MRTS59	<i>Manufacture of Fibre Reinforced Polymer (FRP) Composite Girders</i>
MRTS78	<i>Fabrication of Structural Steelwork</i>
MRTS81	<i>Bridge Bearings</i>

4 Quality system requirements

4.1 Hold Points, Witness Points and Milestones

General requirements for Hold Points, Witness Points and Milestones are specified in Clause 5.2 of MRTS01 *Introduction to Technical Specifications*.

The Hold Points, Witness Points and Milestones applicable to this Specification are summarised in Table 4.1.

Table 4.1 – Hold Points, Witness Points and Milestones

Clause	Hold Point	Witness Point	Milestones
5.3	1. Acceptance of FRP girders into the road network		

Clause	Hold Point	Witness Point	Milestones
6.1	2. Approval of handling transport and storage of Fibre Composite Girders		Submit handling, transport and storage procedure (14 days)
10.1	3. Approval of girder erection procedure	1. Erection of girders	Submit girder erection procedure (21 days)
10.2			Submit installation procedure for alternate type of FRP composites (21 days)

4.2 Construction procedure

Construction procedures which are required to be submitted by the Contractor to the Administrator in accordance with Clause 6 of MRTS50 *Specific Quality System Requirements* as listed in Table 4.2.

Table 4.2 – Construction procedure

Clause	Procedure
6	Handling transport and storage elements
10	Erection of girders

5 FRP composite girders

The Contractor shall engage a Transport and Main Roads approved FRP composite manufacturer in sourcing the FRP composite girders. Hence the sole responsibility of supplying the FRP composite girders to the project lies with the Contractor who has been awarded the project.

5.1 Manufacture of FRP composite girders

FRP composite girders shall be of the lengths and dimensions shown on the drawings and shall be manufactured in accordance with the requirements of MRTS59 *Manufacture of Fibre Reinforced Polymer (FRP) Composite Girders*.

5.2 Supply of FRP composite girders

FRP composite girders formed into desired shape shall be supplied by the Contractor.

5.3 Acceptance of elements by the Administrator

The Contractor shall provide the FRP composite girder approval certificates to the Administrator prior to installing on a bridge. **Hold Point 1**

5.3.1 Damage to elements

FRP composite girders sustaining damage after delivering to the site, the element shall be set aside until it has been inspected by the Administrator. The Administrator at his discretion will accept or reject the girder.

6 Handling transport and storage

6.1 General

FRP composite girders shall, at all time during handling, transport and storage, be oriented as in the finished structure.

The girders shall be handled with adequate care to eliminate the potential for fracture by impact, undesirable bending, twisting and whipping. The girders shall be fully suspended when being moved and under no circumstances are permitted to be dragged along the terrain. Hard hammer impact shall be avoided.

The Contractor shall submit the procedure for the handling, transport and storage of girders, not less than 14 days prior to commencement of any such activities. **Milestone**

The above activity shall not be undertaken without the written approval of the Administrator.

Hold Point 2

6.2 Lifting of bridge girder

FRP composite girders shall only be lifted using soft slings and a spreader beam. The soft slings shall be perpendicular to the girder centreline and slings to the spreader beam at an angle no less than 45° to the centreline of the beam.

Girders shall be lifted anywhere between their ends and the third point along its length.

Chains or other abrasive techniques shall not be used without sufficient padding as they can remove the protective coatings from the girders.

The failure radius of a crane or other equipment with load attached shall be evaluated prior to the lifting operation. In the event where the failure radius intersects with a public highway, railway, right-of-way or site access road, arrangement shall be made to restrict all access until all lifting operations are complete. Care shall be taken to avoid impact with any services or overhead power within the anticipated failure envelop.

The Contractor shall ensure that the crane works within its capacity and shall provide the Administrator, if requested, the crane manufacturer's load chart, including the counter weight, jib length and rig details.

The design of any temporary works required during lifting operation shall be certified by a Registered Professional Engineer Queensland (RPEQ) engineer.

Jacking of the FRP composite girder is permissible where it is necessary, provided that sufficient bearing area is used to spread the load into the girder. A minimum bearing area of 200 mm x 200 mm is recommended by utilising either hardwood timber or steel plates without sharp edges or corners.

6.3 Transport

6.3.1 General

The Contractor shall not transport the girders until all inspections required by the Administrator have been satisfactorily completed.

6.3.2 Mass of loads

All road transport shall comply with the vehicle limits prescribed by the *Transport Operations (Road Use Management) Act and Regulations 1995*.

6.3.3 Escorts and pilots

All road transport shall comply with the relevant clauses of the Traffic Regulations pertaining to provision of pilot vehicles and/or police escorts.

6.3.4 Support of girders during transport

FRP composite girders shall be supported during transport so that no damage is sustained to the girders. The girders shall be supported on timber bearers on level and coplanar.

Girders shall be stacked no more than three high with supports to separate each layer. Supports for upper layers shall be placed directly above the supports of the layer below.

Girders shall be supported on two level bearers secured to the girder and placed between 200 - 2000 mm from each ends when transporting the girders. Girders shall be supported in their final orientations. Sides of the girders shall be protected for abrasion twist and fall during transport.

Material used to support the girders shall not damage or stain the product

Girders shall be braced to prevent from overturning and whipping.

During transport, timber packing elements shall be placed between adjacent girders for the full depth to prevent contact between girders. The packing pieces shall be secured to prevent being dislodged during transport. Independent padded slings or chains with padding shall be used at the each end of the girders to secure the girders firmly.

6.4 Storage of fibre composite elements

Fibre composite girders shall be stored clear of the ground on adequate supports (timber bearers) placed on a plane surface in a manner that shall avoid damage, twisting or warping. When wet or dry, the ground shall not be liable to subsidence under the weight of the elements.

The girders shall not rest on any location other than the specified support points.

Girders shall be laterally braced from overturning. Alternative support arrangement shall be subjected to approval of the Administrator.

7 Materials

7.1 Epoxy putty

Epoxy putty shall consist of a proprietary two-part epoxy product capable of gap filling between the restraint angle and the headstock, and between the bearing and the girder soffit.

A certificate from the manufacturer shall be provided to verify the suitability of the product for the intended purpose. The epoxy putty shall be approved by the Department of Transport and Main Roads.

7.2 Bearings

Laminated elastomeric bearings shall comply with the requirements of MRTS81 *Bridge Bearings*.

7.3 Girder restraint angles

Girder restraint angles shall be fabricated to the details shown on the Drawings.

Fabrication shall be in accordance with the requirements specified in MRTS78 *Fabrication of Structural Steelwork*.

Girder restraint angles shall be hot-dipped galvanised after fabrication in accordance with AS/NZS 4680 *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*.

7.4 Girder restraint fasteners

Girder fastening bolts, nuts and washers shall be supplied and fabricated as shown on the Drawings. Fastener bolts and nuts shall be hot-dip galvanised in accordance with AS 1214 and washers to AS/NZS 4680.

8 Use of epoxy adhesive

8.1 General

Material use and handling shall be in accordance with the manufacturer's recommendations.

8.2 Surface preparation

For components supplied with peel-off surface protection to joint areas, the protection shall not be removed until immediately before placing the adhesive. Peel surface shall be cleaned in accordance with the girder manufacturer's direction.

For joint surfaces without peel-off protection, the surface shall be sanded with 120-grit paper immediately prior to jointing to give a uniform mat surface. All dust shall be removed with oil-free compressed air.

8.3 Part pack mixes

Where less than a full pack of adhesive is mixed at any time, the volume of resin, hardener and filler (if applicable) shall be measured out to be mixed in calibrated containers in the manufacturer specified proportions.

9 Site cutting / drilling timber bridge renewal

The contractor shall comply with the FRP girder manufacturer's guideline in cutting and drilling. The contractor shall use the tools recommended by the FRP manufacturer and seal the drill holes as per the manufacturer's guideline to prevent water ingress.

Fibre composite girders shall only be cut or drilled in locations physically marked on the girders.

In the event any site cutting being required, the manufacturer shall be consulted. Cutting of girders will expose fibres and sealing of cut edges shall be carried out by the site crew as directed by the fabricator.

The contractor shall not drill the girders for any temporary purposes without the prior approval of the Administrator.

9.1 Protective coating

The exterior coating on FRP girders shall not be damaged during erection process. All exposed surfaces, deliberately formed surfaces and abrasion damage shall be protected as per manufacturer's recommendation.

10 Erection of FRP composite girders

10.1 General

The contractor shall submit the erection procedure to the Administrator for erection of girders not less than 21 days prior to commencement of this activity. **Milestone**

It is anticipated that the centre beam will be placed first, the end diaphragms bolted to that beam and the outer beams placed last and then attached to the diaphragms. It is further anticipated that the beams will initially be stabilised by temporarily installing the restraint brackets on headstocks and installing the bolts through the beam before removing the lifting gear. The edge will be pre-fitted with the steel diaphragms.

Erection of girders shall not proceed until the procedure has been approved by the Administrator.

Hold Point 3

Erection of girders shall be a Witness Point. **Witness Point 1**

The Administrator shall have the right at all times to stop any handling which is likely to damage the girders.

10.2 Timber bridge renewal

The installation procedures for a single girder replacement in one span shall be in accordance with the following Standard Drawings:

- Standard Drawings 2280 and 2281 for LOC 400/LOC 420 types, and
- Standard Drawings 2285 and 2286 for WCFT–S1, S2 and S3 types.

For timber bridge rehabilitation using alternate type of FRP composite girders, the contractor shall submit installation procedures not less than 21 days prior to commencement of work. **Milestone**

The contractor shall avoid sliding the fibre composite girder on top of a concrete headstock or pier. In the event that this is not feasible, the contractor shall use a cushioning material between the fibre composite girder and the concrete surface to prevent damage to the fibre or the protective coating.

Jacking the adjacent timber girders to create sufficient clearance shall be considered.

10.2.1 Packing

Packers shall be used on FRP girders to ensure a snug fit between corbels and the bridge deck.

Full bearing area of the beam on to the corbel shall be packed. The bearing area shall not be beyond the specified allowable support area of the beam. The packing material shall be hardwood or the choice of material proposed by the manufacturer, with the packing being placed prior to drilling and installing the fixed rod through the corbels. The packing shall be secured to prevent from walking out.

There shall be no gap between the FRP composite girder and the timber deck. Low viscosity epoxy resin shall be injected to eliminate gaps between the girder and the deck if required.

10.3 Installation of bearings on non-timber corbels

10.3.1 Preparation of bearing seat

The bearing seat shall be thoroughly cleaned prior to installation of the bearing. If a curing compound has been applied to the bearing seat, it shall be removed by grinding or sand blasting then cleaned of dust and other foreign materials with fresh water.

10.3.2 Installation of elastomeric bearings

Elastomeric bearing shall be placed within ± 3 mm of the correct plan position on the bearing seat.

10.4 Installation of FRP composite girders

10.4.1 General

Unless otherwise noted, FRP girders shall not be seated at any position other than at the bearing point.

All holding down bolts and cored holes shall be carefully aligned during placing of FRP girders.

10.4.2 Seating girders on laminated elastomeric bearings

Non-compressible temporary packers shall be installed on top of the headstock to support the girders. The packers shall be of sufficient strength to support the weight of the girders and of such a height that the soffit of the girder clears the bearings by 1 to 5 mm at the closest point. The girder soffit level shall be set to minimise the level differences on the girder top. Immediately prior to installing the girders, a coating of epoxy putty of suitable viscosity shall be applied to the bearings. The girders shall be lowered carefully onto the packers allowing the excess putty to be displaced. The girder shall be checked to ensure it is fully bedded on the epoxy and the excess shall be cleaned off before it hardens. In the case of the girder not fully seated or the putty hardens before the girder is seated, the girder and bearing shall be cleaned of all putty before repeating the operation.

The temporary packers shall be removed only after the epoxy putty has reached strength.

The girder shall be supported before releasing the load from the lifting gear to prevent accidental overturn. Methods to prevent overturning include temporary installation of the restraint brackets and bolts.

As each girder is erected, it shall be fixed to the adjacent previously erected girder using the end diaphragms.

10.4.3 Installation of girder restraint

The girder restraint angles shall be permanently seated after the deck has been installed and reached the sufficient strength.

The girder restraint angles shall be completely bedded on epoxy putty.

The restraint angles at the fixed end shall be installed first. The restraint angles shall be installed in such a manner that the girder presses hard against the restraint angles. The thickness of the epoxy putty shall be such that the girder restraint fastener touches the top of the holes in the girder restraint angles.

At the expansion joint end of the girder, the girder restraint angles shall be installed in such a manner that the girder restraint fastener is located mid-way along the length of the slotted hole in the girder restraint angle. The thickness of the epoxy putty shall be such that the beam restraint fastener touches the top of the slots in the girder restraint angles.

The girder restraint angles shall be supported in the correct positions until the epoxy putty has hardened. After the epoxy putty has cured, all nuts shall be secured and tightened before removing the load on the lifting gear.

