TS 01100:1.0

CRN CP 234

Specifications

Engineering Specification Concrete Turnout Bearers

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Document information

Owner:	Director Corridor Infrastructure & Engineering, AMB, SER
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Discipline	Civil

Document history

Revision	Effective date	Summary of changes
Version 1.2	30 January 2022	TfNSW template applied
Version 2.0	30 January 2022	Internal release only – no change
Version 3.0	30 January 2022	First full UGLRL release

Table of contents

1. Scope and Application

This specification details requirements for the design and type approval of prestressed concrete turnout bearers complete with resilient fastenings and insulators.

It is applicable for turnout bearers used on CRN track infrastructure to meet the requirements of CRN Engineering Standard CRN CS 230 “Sleepers and Track Support”.

Concrete bearers for special applications, including multi-gauge tracks, are not covered by this specification.

2. References

2.1. Australian and International Standards

AS 1085.1	Rails
AS 1085.14	Prestressed Concrete Sleepers

Unless otherwise specified, all references relate to the latest standard versions, including amendments and relevant superseding standards.

2.2. CRN Documents

CRN CS 200	Track System
CRN CS 210	Track Geometry and Stability
CRN CS 220	Rail and Rail Joints
CRN CS 230	Sleepers and Track Support
CRN CS 250	Turnout
CRN CM 203	Track Inspection
CRN CP 204	Product Approval
CRN CP 236	Resilient Fastenings for Concrete Sleepers

2.3. Other References

Nil.

3. Definitions

Prestressed concrete bearer	Concrete bearer where the deformed reinforcing bars (tendons) are stressed before casting the concrete.

Cast in shoulder	A component that prevents lateral movement of the rail foot and provides anchorage for the resilient fastening system.
Cast in synthetic Insert	A component that allows a screwspike to provide lateral restraint for turnout switch plates.
Resilient Fastenings	Elastic steel clips attached to bearers and designed to engage rail flanges. These clips fasten rails to the bearers providing lateral support. Standard resilient fastenings also generate toe load at the rail flange providing resistance to longitudinal movement.
TAL	Tonnes Axle Load

Refer to AS 1085.14 for other definitions.

4. Design Requirements

The design shall be based on relevant Australian Standards and Codes of Practice except where otherwise specified in this document.

Concrete bearers shall be designed in accordance with Australian standard AS 1085.14 - (Railway Track Material; Part 14: Prestressed Concrete Sleepers) unless otherwise specified in this document.

Fastenings, cast in inserts, pads and insulators must comply with CRN CP 236 “Resilient Fastenings for Concrete Sleepers”.

4.1. General information

Bearers shall be designed to operate in the environment detailed in Table 1, which provides design information relating to track and rail operations where the prestressed concrete bearers will be used.

Table 1 – General Information

Criterion	Detail / Description
Track gauge	1435mm gauge with installation tolerance ±4 mm (See CRN CS 210 “Track Geometry and Stability”)
Rail	60 kg/m rail as per AS 1085.1
Rail cant	All running rails shall have zero cant
Signalling	Track circuited signalling – in accordance with CRN Signalling standards.
Climate	Temperate
Locomotive sanding	Sanding is applied for improved traction on extensive lengths of sharp curves and steep gradients Concrete bearers shall be designed to minimise potential for soffit abrasion and rail seat erosion in the operating environment
Curve Radius	As per CRN CS 250, or as per applicable design
Signalling	Track circuited signalling – in accordance with CRN signalling standards
Nominal distance between axles	1.8 metres 30 tonne axle load 1.7 metres 25 tonne axle load 1.6 metres 23 tonne axle load
Minimum Service life	50 years
Electrical Insulation	Bearers and fastenings together with open track panels shall ensure a minimum electrical resistance between running rails of 10 ohms per track kilometre
Load distribution factor	Use 60kg/m rail
Thermal expansion and contraction	Thermal expansion and contraction forces act on the continuously welded rails with a rail temperature range from -10°C to 75°C about a neutral rail temperature of 35°C

Maximum train speeds to be used are specified in CRN CS 200 Track System“ and detailed in Table 2.

Table 2 – Maximum Train Speed

Axle Load / Traffic Classification	19TAL	22TAL	23TAL	25TAL	30TAL
Max Super Deficiency	75 mm	75 mm	110 mm	75 mm	75 mm
Maximum Speed on Tangent Track	160 km/h	115 km/h	100 km/h	80 km/h	80 km/h

Track geometry assumptions (curvature, gradient, superelevation, cant deficiency etc.) shall to be in accordance with the requirements detailed in CRN CS 210.

4.2. Track information

Track configuration and operating requirements to be used are specified in CRN CS 200 and detailed in Table 3.

Table 3 – Track information

Parameter	Class 1 Track
Nominal ballast depth	300 mm
Nominal track modulus	30 MPa
Nominal track condition index (TCI)	45 to 50
Axle Load	25 tonnes
Bearer Centres	600 mm
Annual Tonnage	20 mgt

4.3. Bearer dimensions

Table 4 – Bearer Dimensions

Parameter	Dimension
Bearer length	Varies; 2.5 to 7.5 metres
Limits of cross section (width)	240 mm - 300 mm
Limits of cross section (depth)	220 mm - 300 mm
Rail pad size (e-clip fastenings)	148mm x 180mm x 7 mm (+/- 0.5)

The dimensional tolerances for approved designs shall be in accordance with Table 5.

Table 5 – Tolerances on concrete bearer dimensions

Length	+ 10 mm / - 5 mm
Width	± 3 mm
Depth	± 3 mm

Once bearer depth has been selected for infill panel members or longest turnout members as appropriate, depth of members shall be arranged to ensure the underside of all members form a single plane.

If the bearer depth required in the design is greater than 300mm, consideration should be given to using spliced bearers.

All bearer surfaces must be flat (non-curved) excepting the longitudinal top edges, which must be rounded to a nominal 10mm radius. The base surface may be rough-cast but the top and side surfaces shall be smooth to prevent retention of moisture and foreign material.

4.4. Bearer design information

Table 6 – Bearer design information

Parameter	Value
Design Rail Seat Load	160 kN
Design Bending Moments	As per Appendix A
Design Shear Forces	As per Appendix A

Concrete and tendon stresses at transfer and under service loads shall be in accordance with AS 1085.14 - Prestressed Concrete Sleepers.

4.5. Fastening design information

Table 7 – Fastening design information

Parameter	Value
Minimum clamping force on a rail seat using approved cast-in fastenings	21 kN
Longitudinal static and dynamic creep resistance per rail seat	12 kN

Synthetic inserts shall be threaded internally and externally so as to be replaceable and be provided with protective plugs to prevent entry of foreign material.

Other design and testing details shall be as specified in CRN CP 236.

4.6. Ancillary equipment

Provision for point machines shall be allowed for in the “A” and “B” bearers at the points. If swing nose crossings are used provision for the fastening of point machines is also required for the bearers affected at the crossing location.

4.7. Manufacturing

Approved designs shall be manufactured and tested in accordance with AS 1085.14.

5. Handling and maintenance performance

It is preferable that the bearers can be installed by turnout transportation and layout equipment. Preference shall be given to designs where manual work such as the fitting of pads, insulators and installation of fastenings is kept to a minimum.

Trackwork fitted with concrete bearers must be suitable for maintenance with conventional track maintenance equipment. Such equipment may include tamping machines, track adjustment jacks, track lining machines and fastening insertion/removal equipment.

6. System performance

System performance requires the concrete bearer assembly to function as part of the track structure. The bearer must be able to transfer all the relevant track forces generated by train operations and the forces of rail thermal expansion and contraction to the ballast.

Pads must possess sufficient edge stiffness to prevent the bearer from tilting (about its longitudinal axis) in order to resist longitudinal track forces arising from thermal expansion, contraction and rail creep.

The area of the bearer bases must be adequate to ensure an even load distribution through the ballast bed with maximum ballast pressure.

7. Allowance for retro-fit

There is no allowance for retro-fitting of concrete bearers

8. Bearer marking

The following marks shall be displayed on each bearer

- Mark of Manufacture.
- Year of manufacture with 50 mm high numbers.
- Batch number and date stamp.
- Lettering and marks shall be on the upper surface of the bearer between the rail seats.

9. Type approval requirements

The following type approval requirements apply to new designs of concrete turnout bearers.

New bearer designs shall undergo tests to prove the design in accordance with AS 1085.14-Prestressed Concrete Sleepers.

The supplier will be required to provide:

Design Documentation

- One set of design calculations including the following:
    - Fastening assemblies with all cast-in components, insulators and clips.
    - Tendon design stress including strain relaxation.
    - Tendon bond stress including losses from interface bond/anchorage.
    - Concrete strength including shrinkage creep and curing effects.

  - The complete integrated bearer system as a unit including spalling and delamination effects.
  - The effects on bearer strength from manufacturing tolerances (eg. concrete shape and tendon placement) and the design attrition allowance.
- Two sets of fully detailed drawings including fastening assembly detailing:
  - Tendon type, size and material.
  - Shoulder type, detail and material.
  - Insert details and material.
  - Insulator type, detail and material.
  - Clip type, detail and material.
  - Concrete mixture specification and properties.
  - Concrete curing specification.

The supplier will also be required to provide documentation of testing outcomes.

User Documentation

The following information shall be in a form suitable for inclusion in CRN CM 251 “Turnouts” and/or CRN CM 203 “Track Inspection”:

- Safety instructions including bearer handling and installation and safe fastening installation procedures.
- Spacer and insulator installation methods.
- Maintenance documentation giving details of inspection requirements including frequency, method and requirements.
- Bearer installation and maintenance requirements and methods, including any special tools and equipment.

Appendix A Bending moment and shear force envelopes

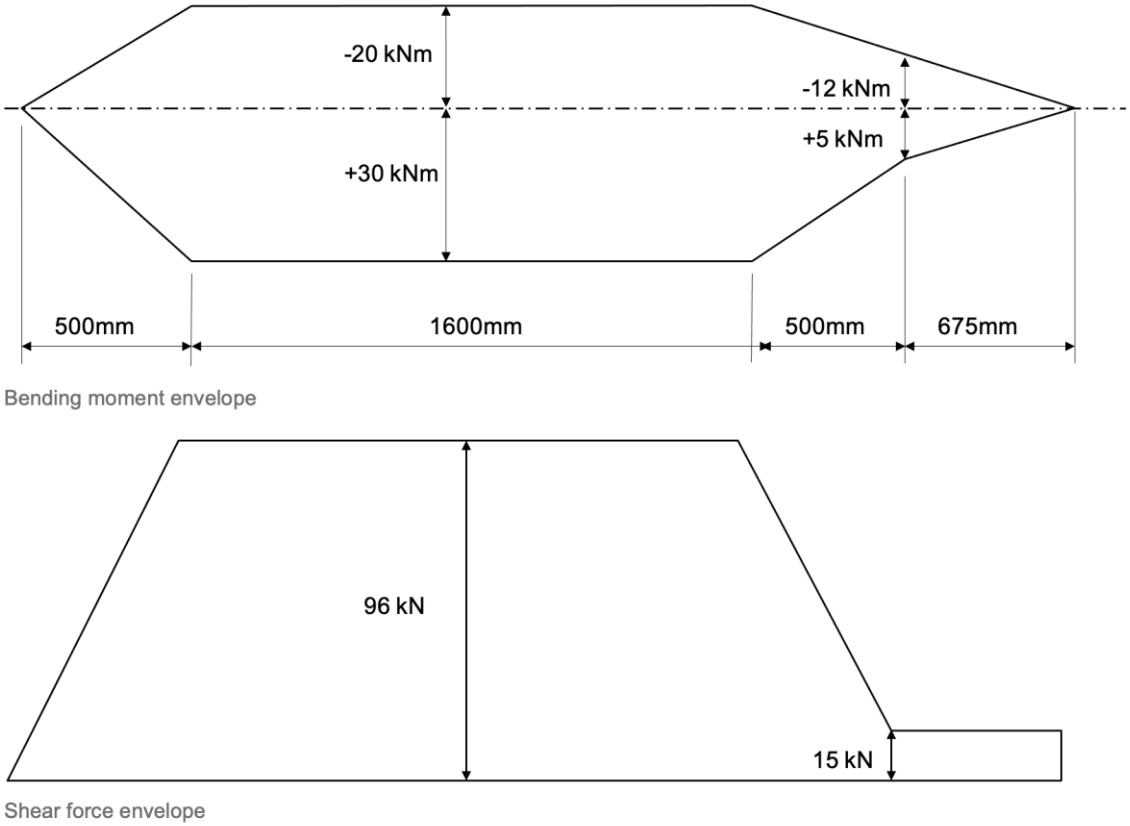
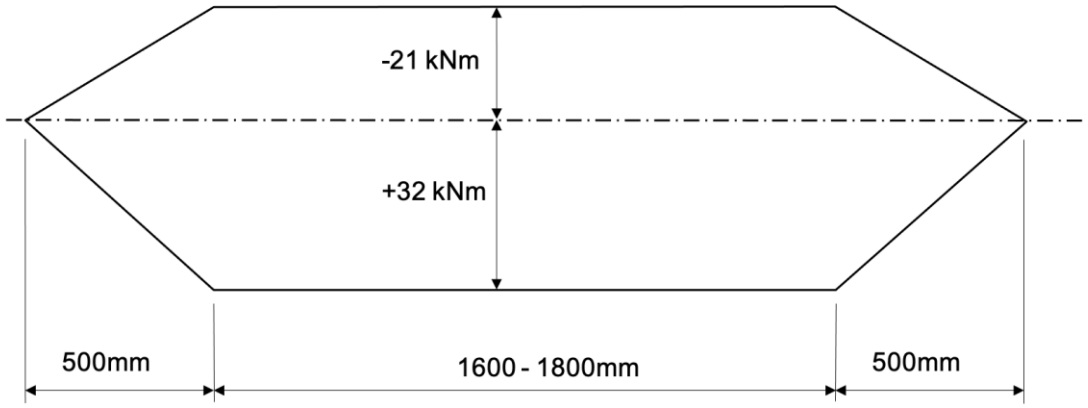
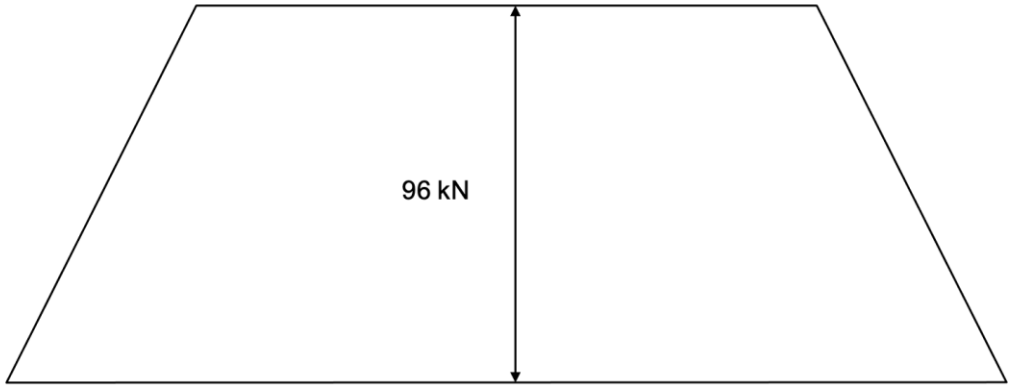


Figure 1 - Bending moment and shear force envelope for turnout ties TYPE " A " - for points motor

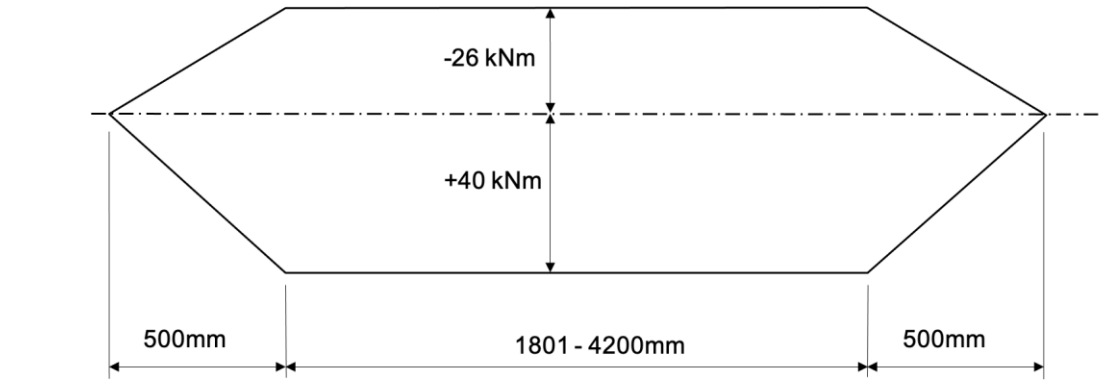


Bending moment envelope

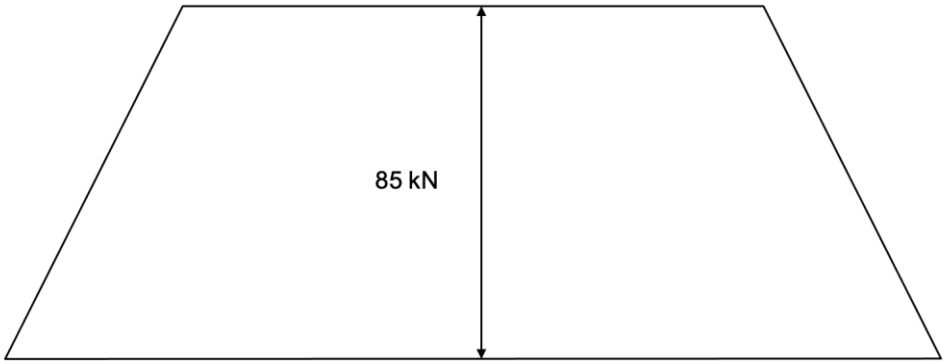


Shear force envelope

Figure 2 - Bending moment and shear force envelope for turnout ties Type " B " - length 2.600 - 2.800 metres

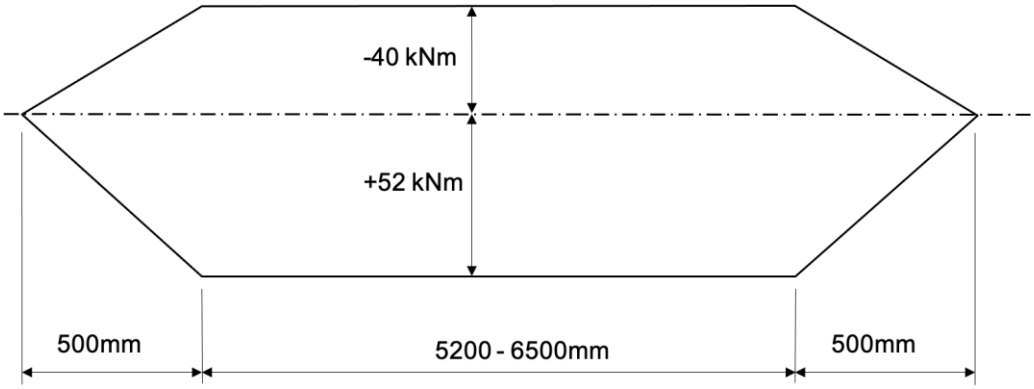


Bending moment envelope

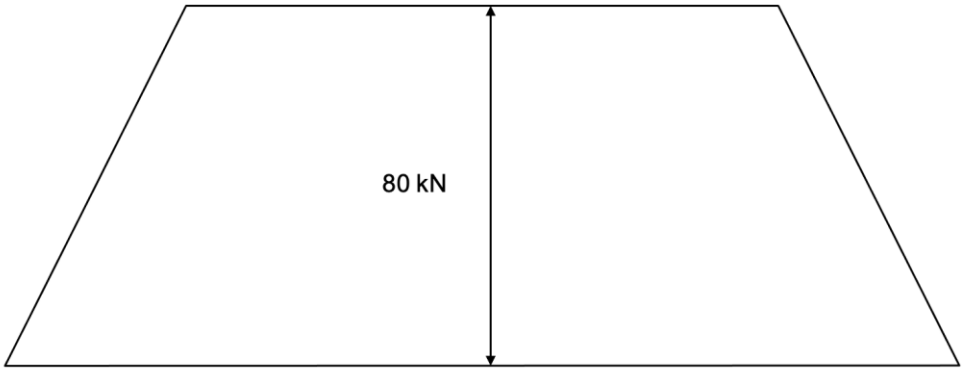


Shear force envelope

Figure 3 - Bending moment and shear force envelope for turnout ties Type " C " - length 2.801 – 5.200 metres

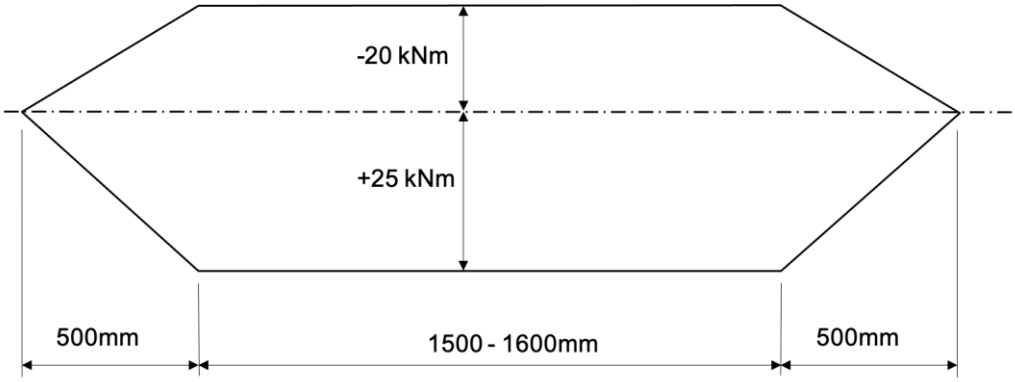


Bending moment envelope

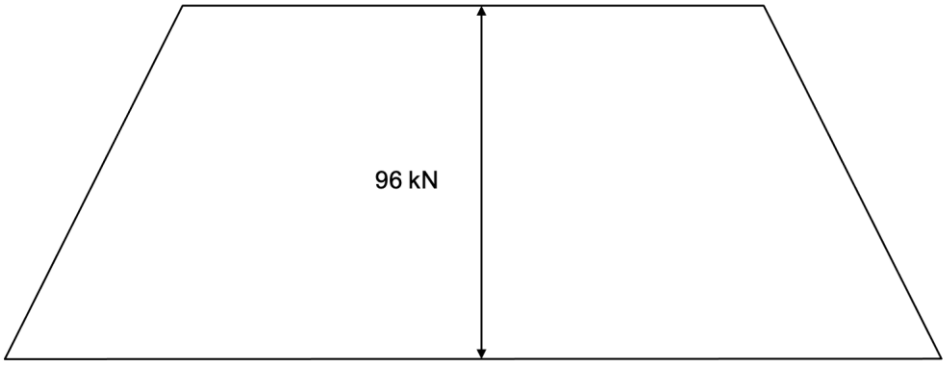


Shear force envelope

Figure 4 - Bending moment and shear force envelope for turnout ties Type " D " - length 6.200 - 7.500 metres (ACROSS PARALLEL TRACKS)



Bending moment envelope



Shear force envelope

Figure 5 - Bending moment and shear force envelope for turnout ties Type " F " – Flat Ties