**Engineering Specification**
**Track**

# SPC 233

# CONCRETE TURNOUT BEARERS

**Version 1.4**

**Issued June 2012**

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Engineering Specification



| | | | |
|---|---|---|---|
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NSW Transport RailCorp

# Document control

| Version | Date | Summary of change |
|---|---|---|
| 1.0 | October, 2006 | First Issue as a RailCorp document |
| 1.1 | December, 2009 | Three year review; Format change only |
| 1.2 | July, 2010 | Correction of incorrect document number |
| 1.3 | August, 2011 | Secttion 4.2 - Addition of tighter gauge tolerances near switch and crossing. Section 7 - New section – allowance for retrofit includes requirements for reinforcement free zones. Section 8-9 - Renumbered |
| 1.4 | June, 2012 | Changes detailed in summary table below |

## Summary of changes from previous version

| Summary of change | Section |
|---|---|
| Control changes | Document Control |
| Reformatted to new template | All |

# 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 in RailCorp to meet the requirements of RailCorp standard ESC 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

All references relate to the latest standard versions, including amendments and relevant superseding standards.

## 2.2 RailCorp Documents

ESC 200 - Track System

ESC 210 - Track Geometry and Stability

ESC 230 - Sleepers and Track Support

ESC 250 - Turnouts and Special Trackwork

SPC 234 - Resilient Fastenings

## 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. |

# 4 Design Requirements

## 4.1 General

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 RailCorp specification SPC 234.

## 4.2 General Information

| Criterion | Detail / Description |
|---|---|
| Track gauge | 1435mm gauge with installation tolerance ±4 mm (Note 1) (See RailCorp standard ESC 210).<br>Note: 1. Tighter tolerances of ± 2 mm are required for bearers within 1.2m of the switch tip and bearers within 1.2m of the crossing nose in order to meet the acceptance standards of RailCorp standard ESC 250 |
| Rail | AS 1085.1 - 60 kg/m rail. |
| Rail cant | All running rails shall have zero cant. |
| Electric traction | 1,500 Volt D.C. |
| Signalling | Track circuited signalling. |
| Climate | Temperate. |
| Locomotive sanding | Sanding is applied for improved traction on extensive lengths of sharp curves and steep gradients.<br>Concrete bearers shall be designed to minimise potential for soffit abrasion and rail seat erosion in the operating environment. |
| Nominal distance between axles | 1.8 metres 30 Tonne axle load.<br>1.7 metres 25 Tonne axle load.<br>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. |
| 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. |

**Table 1 - General Information**

Maximum train speeds to be used are specified in RailCorp standard ESC 200 and detailed in Table 2.

| Axle Load / Traffic Classification | 25TAL - T5 | 19TAL - T1 | 19TAL - TM2 | 22TAL - T2 | 30TAL - T6 |
|---|---|---|---|---|---|
| Max Super Deficiency | 75 mm | 110 mm | 110 mm | 75 mm | 75 mm |
| Maximum Speed on Tangent Track | 80 km/h | 160 km/h | 140 km/h | 115 km/h | 80 km/h |

**Table 2 - Maximum Train Speed**

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

## 4.3 Track Information

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

| Parameter | Heavy Freight Option | Mixed Passenger - Freight Line | Passenger Line |
|---|---|---|---|
| Nominal ballast depth | 350 mm | 300 mm | 250 mm |
| Nominal track modulus | 30 mPa | 30 mPa | 25 mPa |
| Nominal track condition index (TCI) | 40 to 45 | 45 to 50 | 45 to 50 |
| Axle Load | 30 tonnes | 25 tonnes | 21 tonnes |
| Bearer Centres | 600 mm | 600 mm | 600 mm |
| Annual Tonnage | 70 mgt | 20 mgt | 20 mgt |

**Table 3 - Track information**

## 4.4 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) |

**Table 4 - Bearer Dimensions**

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

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

**Table 5 - Tolerances on concrete bearer dimensions**

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.

## 4.5 Bearer Design Information

| Parameter | Value |
|---|---|
| Design Rail Seat Load | 160 kN |
| Design Bending Moments | As per Figure 2 to Figure 6 Appendix A |
| Design Shear Forces | As per Figure 2 to Figure 6 Appendix A |

**Table 6 - Bearer design information**

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

## 4.6 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 |

**Table 7 – Fastening design information**

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 SPC 234.

## 4.7 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.

## 4.8 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

For plated bearer designs there shall be two zones running the length of the bearer that are clear of reinforcement and which can be used for repair, or retrofitting of equipment. These zones are defined in Figure 1. This includes an allowance of 10mm clearance to the reinforcement. Any cored holes shall be perpendicular to the bearer top surface (i.e. vertical in the installed position) to maintain this clearance. Cored holes shall be no

deeper than 190mm from the top surface and the maximum diameter of any cored hole shall be 50mm. No hole shall be placed closer than 2 diameters from another hole unless the existing holes are filled. Epoxy suitable for high strength concrete repair, with similar mechanical and thermal expansion properties and strength >50Mpa, shall be used.

Note: Existing holes for screwspikes in a bearer should be within the zones in Figure 1. If this is not the case design advice should be sought before any coring is carried out.

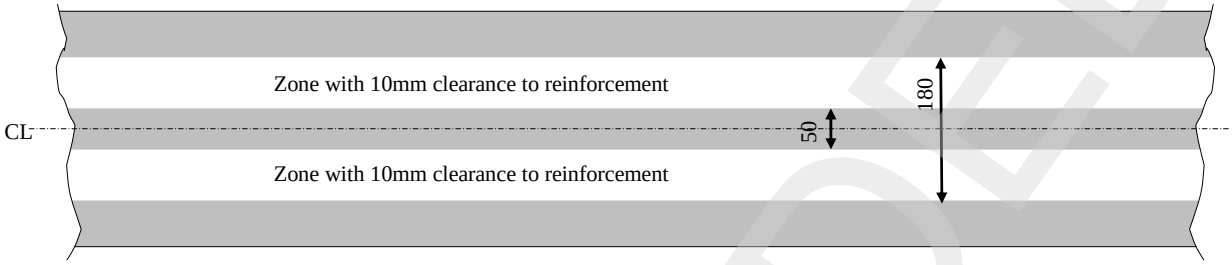



**Figure 1 – Reinforcement free zone**

# 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:

- 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.

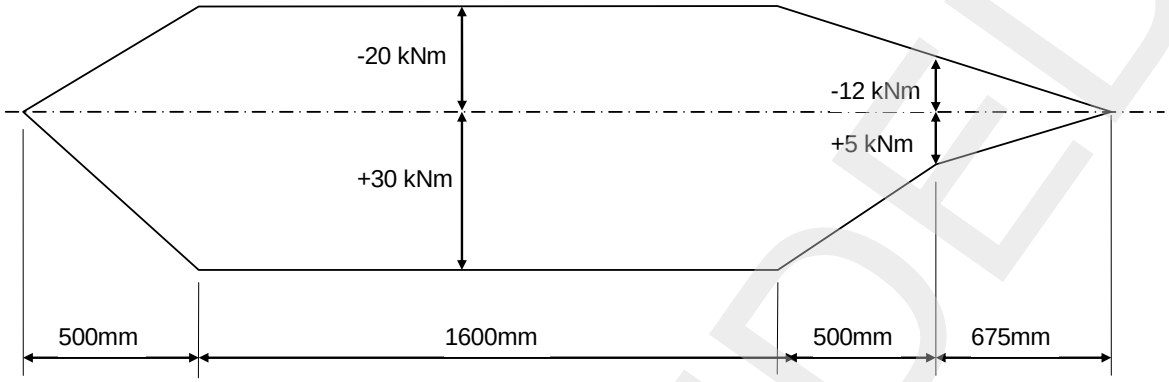
Two sets of fully detailed drawings including fastening assembly detailing:

- 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.

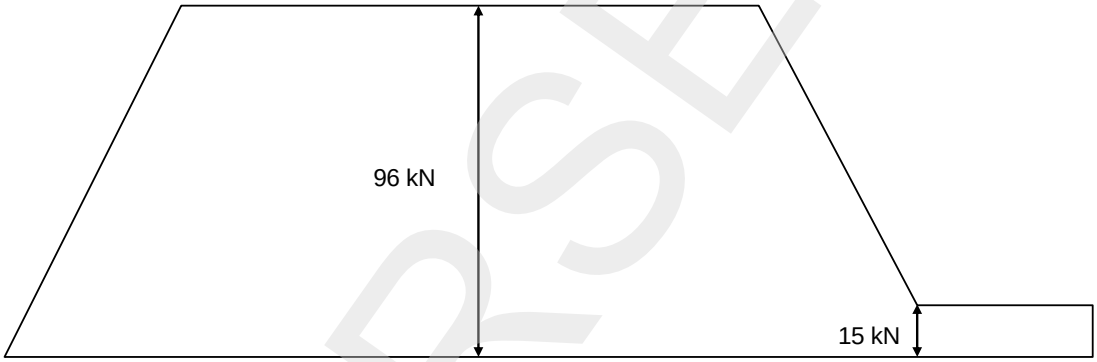
- Concrete curing specification.

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

# Appendix A Bending Moment and Shear Force Envelopes




*Bending moment envelope*




*Shear force envelope*

**Figure 2 - Bending moment and shear force envelope for turnout ties TYPE " A "" - for points motor**

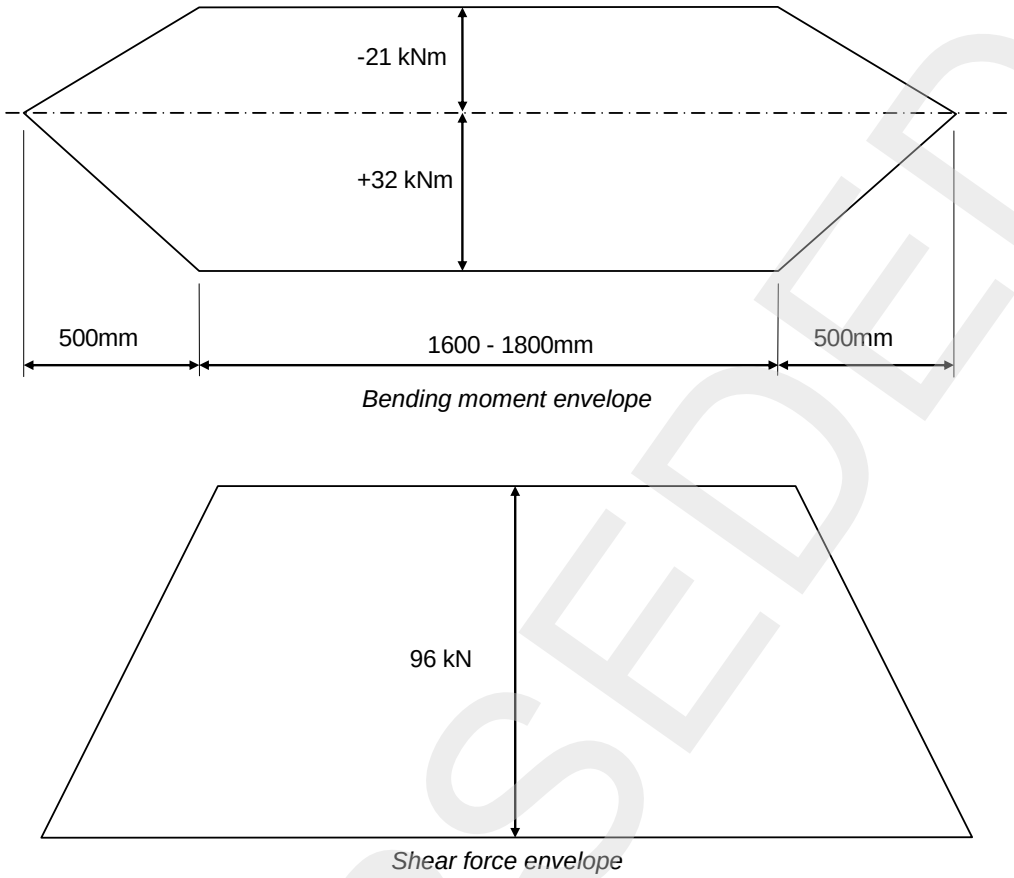



**Figure 3 - Bending moment and shear force envelope for turnout ties Type " B " - length 2.600 - 2.800 metres**

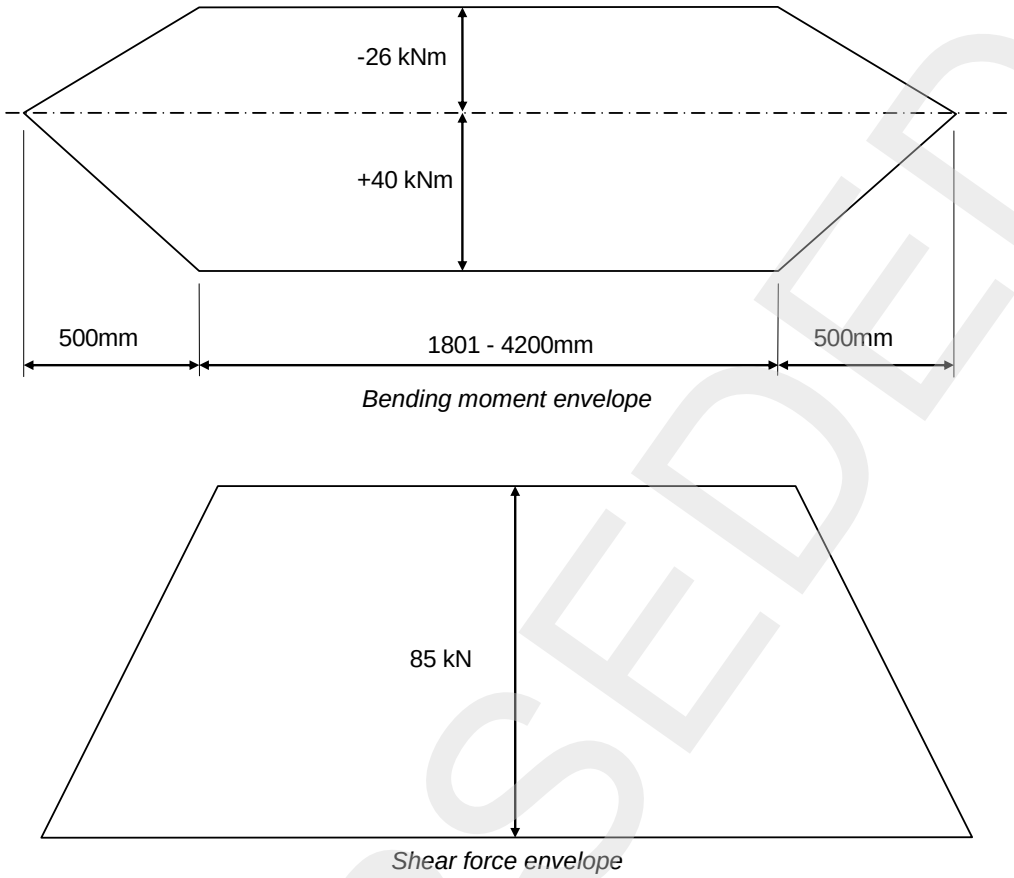



**Figure 4 - Bending moment and shear force envelope for turnout ties Type " C " - length 2.801 – 5.200 metres**

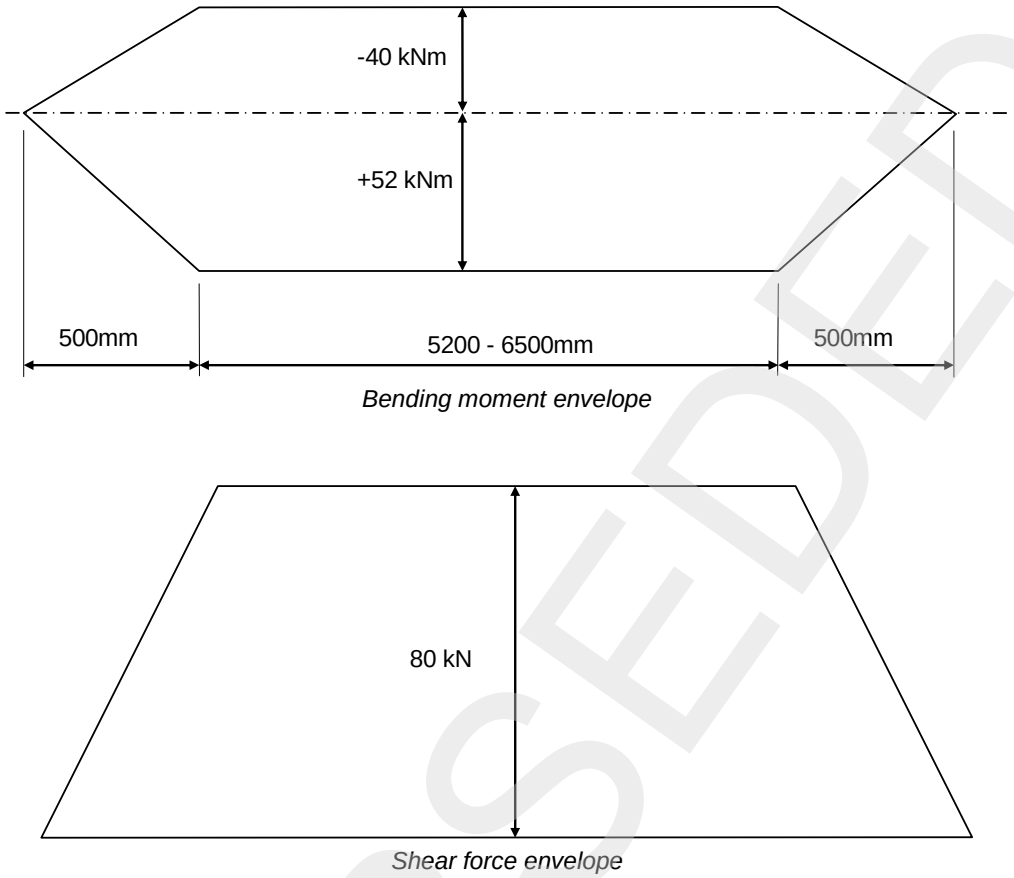



**Figure 5 - Bending moment and shear force envelope for turnout ties Type " D " - length 6.200 - 7.500 metres (ACROSS PARALLEL TRACKS)**

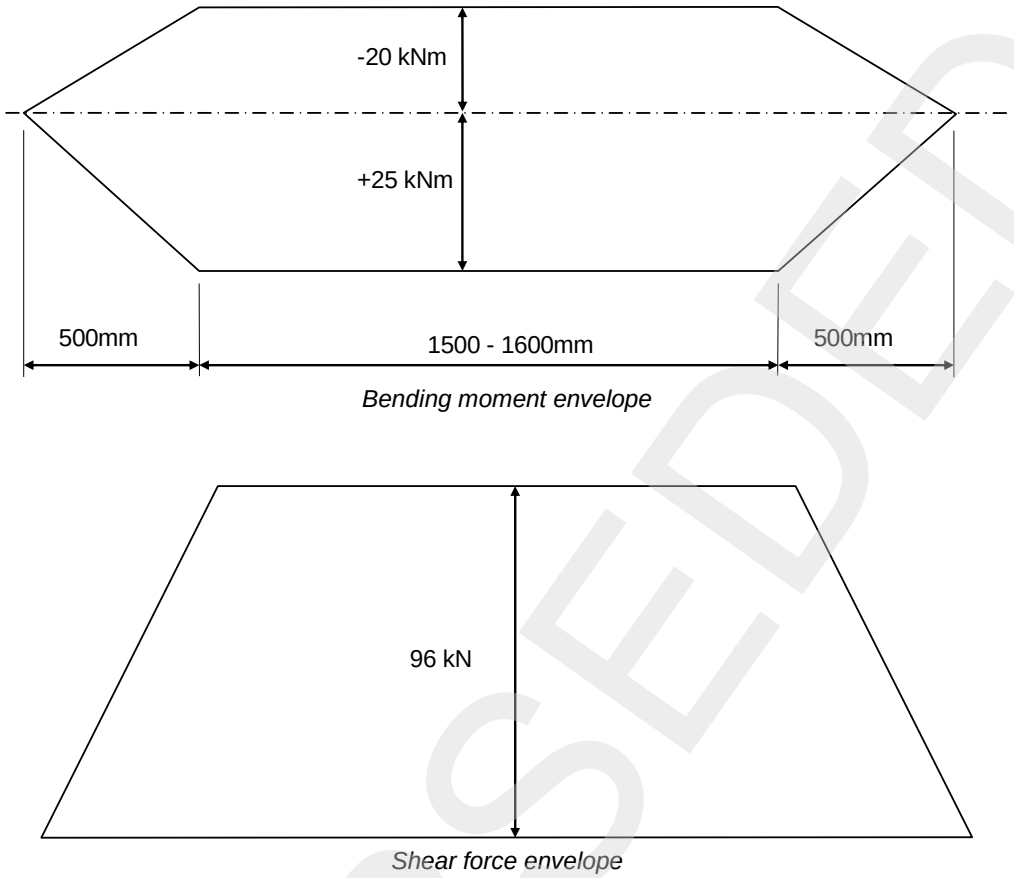



**Figure 6 - Bending moment and shear force envelope for turnout ties Type " F " – Flat Ties**