# Moseley Railway Trust

**PRESERVING OUR INDUSTRIAL NARROW GAUGE RAILWAY HERITAGE**

Registered Charity No. 1100827

Moseley Railway Trust Safety Procedure

# Procedure MRTSP19 – Site Railway Infrastructure & Trackwork – standards and approvals

Issue:- Six

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Authorised for implementation by:- Chairman, MRT

Dated:-

Document review period:- 60 months

## 1:- Purpose

This document replaces the previous MRTSP19 “Track construction Verification”. The document has been renamed as it now encompasses all railway-related infrastructure on the Apedale site.

The purpose of this document is to:-

- Document the standards that are to be used when railway track is constructed at Apedale.
- Document the processes used when buildings and other non-railway track infrastructure is constructed.
- Provide guidance on the necessary processes to be applied to ensure compliance to the ROGS regulations and the MRT Safety Management System in respect of railway infrastructure.

## 2:- Definitions

In this procedure, the following are used:-
MRT – Moseley Railway Trust
ORR – Office of Rail & Road
PWE – Permanent Way Engineer, an appointed and competent official of the MRT.
Railway Infrastructure – means any construction, earthworks or building which is *directly* related to the operation of the railway at Apedale. It DOES NOT include trackwork (which is covered separately)
ROGS – Railway and Other Guided Systems (Safety) Regulations 2006
ROTS – Railway and Other Transport Systems (Approval of Works, Plant & Equipment) Regulations 1994
SMS – Safety Management System
Trackwork – means sleepers, rails, fastenings and any item directly connected thereto (such as point levers, facing point locks etc.).

NOTE:- This document does NOT cover signalling or complex interlocking systems. These are outside of the scope of the current MRT SMS.

## 3:- Procedure

### 3.1 Railway Infrastructure

Appendix A provides guidance on standards to be applied to structures such as platforms. This appendix also sets standards for where structures may be located with regard to trackwork such that adequate and safe clearances are maintained.

Appendix A provides guidance on the standards to be applied to railway trackbed and the like.

Buildings must be constructed with regard to:-

- Standards contained in Appendix A to this document
- Appropriate building regulations
- Appropriate planning consents
- (this list in NOT intended to be exhaustive).

Caution should be exercised on the Apedale site owing the presence of mining workings, some of which may be close to the surface.

Reference should also be made to RSP5 “Guidance on Minor Railways” (see Section 7).

Guidance on the use of contractors and the CDM Regulations will be found in MRTSP07 (see section 7).

### 3.2:- Trackwork

Trackwork shall be designed and constructed in accordance with the standards defined in Appendix A.

### 3.3:- Identification of Trackwork

MRTSP20 shall be used to provide the register or plan of the trackwork on site. This shall identify each section, and shall state into which maintenance category the section fits, using the categorisation stated in MRTSP20. For reference, this categorisation is as follows:-

| | |
|---|---|
| A1 | Main running lines, the loss of which would halt or seriously disrupt the running of the railway, or impart risk to the travelling public. All lines approved for passenger trains fall into this category |
| A2 | Secondary running lines, the loss of which would halt or seriously disrupt the running of the railway. This also includes lines adjacent to passenger lines, where a derailment could foul a passenger train. |
| B1 | Occasionally used lines. |
| B2 | Storage sidings. |

### 3.4:- Management of Change and approvals – Category A1 track (ie passenger carrying)

### 3.4.1:- Existing infrastructure & trackwork

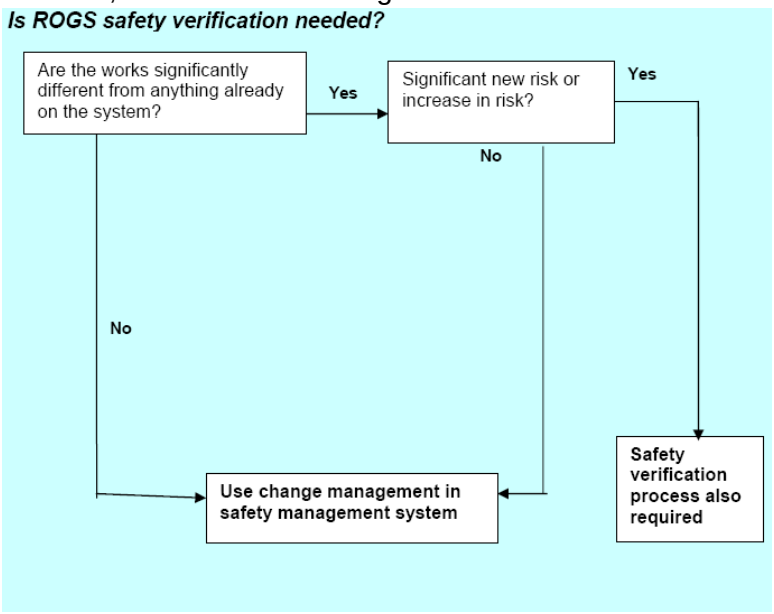
The passenger running line at Apedale from Silverdale station to Apedale road has been approved under the ROTS process.

### 3.4.2:- Subsequent changes

Further changes (including alterations and additions) to infrastructure and trackwork must be handled in accordance with the ROGS regulations.

The following is NOT intended to be a complete guide to ROGS-compliant change management. For further details, and where any doubt exists, it is strongly recommended that reference is made to the ORR document “A Guide to Safety Verification for Heritage Railways” – see section 6.

ROGS has two routes for approvals. The route to be used is determined by applying two tests, as shown in the diagram below:-




If the change fails either test, then the change may be approved via the MRT SMS.

If, however, the change passes BOTH tests, then a Safety Verification process will be required, using an Independent Competent Person. In the event that Safety Verification is required, then the PWE and the Board Member responsible for Safety shall agree on the process to be used for this.

### 3.4.3:- If the Change is to be managed via SMS

If the Change is to be managed via the SMS, then:-

- There must be a project manager for the Change. For trackwork, this will normally by the PWE.

- Project Managers will be named in MRT Trustee board minutes.
- A Management of Change document will normally be required for significant changes to trackwork. The SMS (MRTSMS01) provides guidance on the compilation of such documents.

Section 3.6 provides guidance in the event that infrastructure cannot comply with the standards set out in this document; the creation of further such infrastructure must be supported by a Management of Change document including a risk assessment.

IMPORTANT NOTE:- The Track standards contained in Appendix A were developed in accordance with the standards for railway vehicles and their wheelsets which are contained in MRTSP23 Vehicle Acceptance. The Track standards MUST NOT be changed, amended or deviated from without due consideration being taken of the effect on the complete wheel-rail interface system.

The Board Member responsible for Safety shall, periodically, ensure that this process is being correctly and rigorously applied.

**3.5:- Management of Change and approvals – Other categories of track**

Approvals for other categories of track shall be proportionate to the project. The Trustee responsible for Safety shall judge and action these as appropriate.

Major projects (for example, the Field Railway) should be managed as per section 3.4.

Minor projects (eg a storage siding) do not require any explicit approvals (although they do require inspection per 3.6 below).

**3.6:- Bringing into service new trackwork**

All new trackwork shall be inspected by the PWE prior to it being brought into service.

This inspection shall be carried out in accordance with Operation 2 in MRTSP20 Trackwork Maintenance.

**3.7:- Non-compliant infrastructure**

It is recognised that there may be areas where the infrastructure cannot comply with the standards in this document. A current list of non-compliant infrastructure, and the consequent operations restrictions is as follows:-

| Area | Max Dimensions | Prohibited Vehicles |
|---|---|---|
| Red Shed Road 2 | 6ft wide<br>8ft 4in high | WDLR 40 HP Simplexes +<br>No.90 Baguley Drewry<br>All steam locomotives<br>MoD Vans<br>Bogie Vehicles<br>Penrhyn Coaches |
| Red Shed Road 3 | 6ft wide<br>7ft high | All the above +<br>No.58 Hudswell (HC D558)<br>No. 40 (SMH40SD516)<br>"Sludge" |
| Aurora North Shed | 7 ft wide<br>9 ft high | WDLR 40 HP Simplexes. |

The "master" of this list shall be held as an Appendix to MRTSP25 Railway Rule Book, and shall also be displayed on operational noticeboards.
It is clearly undesirable that infrastructure is non-compliant, but it is accepted that this may be unavoidable; it may therefore be necessary to add to this list if circumstances dictate.

## 4:- Records

The PWE track register (3.3) is a dynamic document; obsolete copies are not records and should be destroyed to prevent confusion.

Project files (3.4.3) shall be retained for not less than 30 years – this being the expected life of the materials used in constructing the railway.

## 5:- Upward References

This document is referred to in MRTSP20 – Trackwork maintenance.

## 6:- Supporting References

The following documents are referred to in this procedure:-

- MRTSMS01 – the MRT Safety Management System
- MRTSP07 – Use of contractors and compliance to CDM regulations
- MRTSP20 – Track Maintenance
- MRTSP23 – Vehicle Acceptance
- MRTSP25 – Apedale Valley Light Railway rule book
- ORR Document "A guide to Safety Verification for Heritage Railways", located at http://www.rail-reg.gov.uk/upload/pdf/381.pdf
- Heritage Railway Association Guidance Note HGR-A0401 "Permanent Way Planning, Inspection & Maintenance".

ORR Document RSP5 "Guidance on Minor Railways" contains a wealth of useful data and is located at http://www.rail-reg.gov.uk/upload/pdf/rsp005-minorrail.pdf

NOTE:- Appendix A to this document is derived from the former MRT Trackwork Manual issue 2, with the following changes made:-

- Trackwork maintenance removed – this now in MRTSP20.
- Details of vehicles and wheelset dimensions removed – this now in MRTSP23.
- Minor amendments to ensure consistency of drafting style
- Re-ordering of sections to improve logical sequence

The Trackwork manual is derived from experience at the West Lancashire Light Railway and the MRT railway at Cheadle.

Reference is made to HSE document “Rail Track and associated equipment for use underground in mines" but is should be noted that the MRT railway does not fully comply with the requirements of this document. This document is available as a pdf at http://www.hse.gov.uk/pubns/mines06.pdf.

This link to the Permanent Way Institution technical hub provides access to various technical papers etc. https://www.thepwi.org/technical_hub/guides

## 7:- Document Change Control

| Issue | Page/Section | Change |
|---|---|---|
| 6 | 1 | Up-issued to Issue 6. |
| | Section 2 | ORR added. |
| | Section 3.3 | Need for “track register” removed, since this dta is held on MRTSP20 -a “register” would simply duplicate that document. |
| | Section 3.3 | Categories re-instated – duplicates MRTSP19, but necessary in revised following sections. |
| | Section 3.4 | Section now only applies to category A1 track; disproportionate to apply full ROGS process to (eg) an extended siding. |
| | Section 3.5 | New section added to cover new trackwork which is now excluded from section 3.4. Subsequent sections renumbered – not blacklined. |
| | Section 6 | HRA document added. Link to PWI added. |
| | Appendix A, 8.1 | Section metricated and vague guidance about sleeper sizes clarified and also reflecting commonly available timber sizes. |
| | Appendix A, 8.1 | Reference to Tanalisation replaced by more generic reference to pressure-treated. |
| | Appendix A, 11.6 | Section re-written to reflect experience gained on check rails, incl:-<br>- B-2-B to take precedence.<br>- Achieving 1/16” criteria not practical.<br>- Allow for gauge widening.<br>- Etc. |
| | Appendix A, 11.9 | As a frequently asked question, footnote added stating where this requirement is to be found. |

## Appendix A:- Standards to be applied to Railway Infrastructure & Trackwork

The following is derived from the former Trackwork manual Issue 2. See Section 6 for description of origin of these standards.

Contents:-

## 1:- Design Standards

NOTE:- These standards are design for compatibility with maximum size of normally acceptable vehicles as defined in MRTSP23, which is:-

- Width 7’0”
- Height 9’0”

MRTSP23 should always be consulted for data on acceptable dimension for railway vehicles. It is ESSENTIAL to understand that the Vehicle standard and the Infrastructure standard must be compatible and complimentary.

### 1.1:- Track formation

A design allowance of 3m (10ft) width at track level should be made for the complete track formation and fencing.

### 1.2:- Gradients

Gradients must be minimised. Track in station platforms and sheds must be level wherever possible. Track should not run downhill towards shed doors, buffer stops or ends of sidings.

### 1.3:- Station layouts

Where possible platforms must be straight to allow the crew to observe the full length of the train. There must be adequate over-run beyond the platform end. The ends of platforms should be ramped down.

### 1.4:- Minimum platform width

The minimum platform width is 2m (6' 6").

### 1.5:- Platform clearance

The platform edge must be 42" +2" / -0" from track centre line.

### 1.6:- Platform height

The platform top must be 3" to 6" above rail

### 1.7:- Minimum track centres

The minimum distance between track centre lines is 9' 0".

### 1.8:- Minimum clearance to structures

The minimum clearance from the track centre line to any structure is 5' 0".

### 1.9:- Structure gauge

Note that additional clearance is required on curves due to overhang and end-throw of vehicles. Consult the PWE before laying any curves of 65ft radius or less within 10ft of a structure. The minimum vertical design clearance for new structures is 9' 6".

### 1.10:- Shed doors

Track entering buildings must be straight. The minimum door width (for a single track) is 8ft. Wherever possible there must be 18ft of straight track outside a shed door. Consult the PWE before laying track if these conditions cannot be fulfilled.

### 1.11:- Minimum curve radii

| Track location | Minimum curve radius |
|---|---|
| Main running lines | 100ft |
| Passenger lines in stations and run-round loops | 80ft |
| Main access to locomotive shed and museum | 65ft |
| Sidings | 37ft |
| Sidings (restricted use) | 25ft |

**Table 1 : Minimum Curve Radius**

### 1.12:- Reverse curves

There must be a minimum length of 12ft (preferably 18ft) of straight track between reverse curves.

### 1.13:- Gauge and Gauge widening on curves

The track gauge on straight track shall be 24”.

Gauge widening up to $\frac{1}{2}$" is permitted on curves less than or equal to 65ft radius.

### 1.14:- Cross-Level and Twist

The maximum permitted cross-level difference (ie vertical height of one rail relative to the other rail) is 3/8”.

“Twist” is rate-of-change of cross-level. The maximum permitted twist is 1 in 144; this can be considered as 3/8” difference with rail “A” high relative to “B” to 3/8” difference with “B” higher than “A”) – ie a total change of ¾” over a running length of 9’ (108”). This is half of the normal minimum rail length (ie joint-to-mid rail distance).

### 1.15:- Superelevation

Superelevation of $1\frac{3}{4}$" maximum may be applied to 100ft radius curves on main running lines. Curved track in platform roads, sidings and loops must not have any superelevation.

### 1.16:- Transition curves

Curves on main running lines must have a gradual transition from straight to curved track. The transition must be approximately 30ft long. The superelevation must be progressively increased along the length of the transition

## 2:- Trackbed formation

### 2.1:- Structures and earthworks

Any structure over or under the line, and any earthworks deeper or higher than 0.5m (20") must be designed and constructed according to the specification of the PWE.

### 2.2:- Sub-base and Geotextile

The track formation sub-base must consist of 100mm (4") of crushed stone without fines. Ground conditions may require the sub-base and drains to be lined with geotextile. The PWE will assess if this is required. The formation width at sub-base must be 2m (78") plus 400mm (16") per side for the cess. There must be a cross fall of approx. 25mm (1") towards the drain.

### 2.3:- Track drains and services

There should be a land drain on one side of the formation. An allowance of 250mm (10") width must be made. The drain must lie in a trench and shall be back filled with crushed stone without fines. The bottom of the drain must be bedded on a layer of fine stone or sand to allow for adjustment of fall. The bottom of the drain must be 200mm (8") below the sub-base at its highest point. The drain must have a fall of at least 1:240 (1" per 20ft). The drain must discharge away from the formation such that it is not susceptible to blockage but must not cause any erosion of the formation.

Chambers should be provided at 18m (60ft) intervals. The floor of the chamber must be 300mm (12") below the bottom of the drain. Chambers must be cleaned annually to remove silt and leaves.

The location of services (water pipes, buried cables, drains etc.) must be recorded on the site plan.

Any services which could pose a hazard when maintaining the railway must be clearly indicated by signs or similar on the railway.

## 3:- Fencing

Fencing must be no closer than 1.5m (5') from the track centre line

## 4:- Rail

### 4.1:- Rail sections

There are two series of rail section in general use:

BS 11 (Old)
BS248 (Mines)

Rail weights in use are 14-20-25-30-35lb/yd.

Appendix B to this document shows a variety of rail sections, and should be used to differentiate these.

The minimum rail section for main running lines including loops and headshunts is 30lb/yd. 20lb/yd may be used for portable track and lightly used sidings. Light track sections may also be used for museum displays and demonstration purposes.

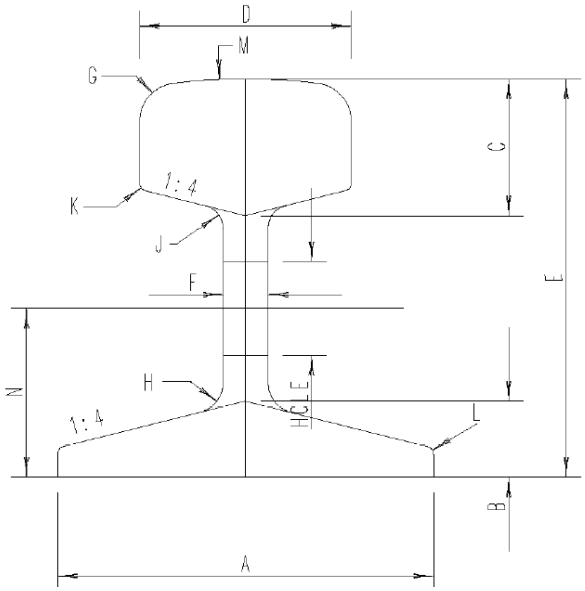



**Figure 1 : BS248 (Mines) Rail Section**

| lb/yd | A | B | C | D | E | F | G | H | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16M | $2^{1}/_{16}$ | $^{25}/_{64}$ | $^{3}/_{4}$ | $1^{3}/_{32}$ | $2^{5}/_{16}$ | $^{1}/_{4}$ | $^{3}/_{16}$ | $^{1}/_{8}$ | $^{1}/_{8}$ | $^{1}/_{16}$ | $^{1}/_{16}$ | 5 |
| 20M | $2^{3}/_{16}$ | $^{31}/_{64}$ | $^{25}/_{32}$ | $1^{7}/_{32}$ | $2^{9}/_{16}$ | $^{17}/_{64}$ | $^{1}/_{4}$ | $^{3}/_{16}$ | $^{3}/_{16}$ | $^{1}/_{16}$ | $^{1}/_{16}$ | 5 |
| 25M | $2^{1}/_{2}$ | $^{17}/_{32}$ | $^{7}/_{8}$ | $1^{3}/_{8}$ | $2^{3}/_{4}$ | $^{21}/_{64}$ | $^{5}/_{16}$ | $^{1}/_{4}$ | $^{3}/_{16}$ | $^{1}/_{16}$ | $^{1}/_{16}$ | 5 |
| 30M | $2^{3}/_{4}$ | $^{19}/_{32}$ | $^{15}/_{16}$ | $1^{1}/_{2}$ | $2^{31}/_{32}$ | $^{23}/_{64}$ | $^{5}/_{16}$ | $^{1}/_{4}$ | $^{3}/_{16}$ | $^{1}/_{16}$ | $^{1}/_{16}$ | 5 |
| 35M | 3 | $^{39}/_{64}$ | $1^{3}/_{32}$ | $1^{11}/_{16}$ | $3^{3}/_{16}$ | $^{23}/_{64}$ | $^{5}/_{16}$ | $^{1}/_{4}$ | $^{3}/_{16}$ | $^{1}/_{16}$ | $^{1}/_{16}$ | 5 |

**Table 2 : BS248 (Mines) Rail Dimensions (inches)**

| lb/yd | A | B | C | D | E | F | G | H | J | K | L | M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | $2^{1}/_{8}$ | | | $1^{5}/_{32}$ | $2^{1}/_{8}$ | | | | | | | |
| 20 | $2^{1}/_{2}$ | | | $1^{3}/_{8}$ | $2^{1}/_{2}$ | | | | | | | |
| 25 | $2^{3}/_{4}$ | | | $1^{1}/_{2}$ | $2^{3}/_{4}$ | | | | | | | |
| 30 | 3 | | | $1^{5}/_{8}$ | 3 | | | | | | | |
| 35 | $3^{1}/_{4}$ | | | $1^{3}/_{4}$ | $3^{1}/_{4}$ | | | | | | | |
| 40 | $3^{1}/_{2}$ | | | $1^{7}/_{8}$ | $3^{1}/_{2}$ | | | | | | | |
| 45 | $3^{3}/_{4}$ | | | $1^{31}/_{32}$ | $3^{3}/_{4}$ | | | | | | | |
| 50 | $3^{15}/_{16}$ | $^{41}/_{64}$ | $1^{5}/_{16}$ | $2^{1}/_{16}$ | $3^{15}/_{16}$ | $^{13}/_{32}$ | $^{11}/_{32}$ | $^{7}/_{32}$ | $^{7}/_{32}$ | $^{1}/_{16}$ | $^{1}/_{16}$ | 12 |

**Table 3 : BS 11 (Old) Rail Dimensions (inches)**

### 4.2:- Rail Lengths

The preferred minimum rail length for use on main running lines is 18ft. Sections of rail shorter than 9ft (short closures) must not be used on passenger lines.

## 5:- Axle loads and sleeper spacing

All main running lines, loops, headshunts and access roads to sheds must be laid with track (rail weight and sleeper spacing) suitable for 5 ton axle loads.

| Rail Weight | Sleeper spacing (Centres) | Maximum axle load |
|---|---|---|
| 30-35 lb/yd | 30” | 5 tons |
| 30-35 lb/yd | 36” | 3.75 tons |
| 20-25 lb/yd | 24” | 3 tons |
| 20-25 lb/yd | 30” | 2 tons |

**Table 4 : Maximum Axle Loads**

## 6:- Fishplates and fishbolts

### 6.1:- Fishplates

The correct type of fishplate should be used to suit the rail section. Each rail section uses its own type of fishplate. Note that the tapers on the top and bottom of the fishplate are different for each standard of rail.

Rust and scale must be removed from fishplates before use. A check must be made that the fishplate is a good fit between the head and foot of the rail. The fishplate must not touch the rail web; it should clamp between the head and the foot. If the fishplate touches the rail web, then either it is the wrong size or section, or it is worn, or the fishing surfaces of the rails are worn or wasted. Undersize fishplates which have been bolted up to the rail web will not hold the rails in alignment or support the rated axleloads. Incorrect installation will result in derailment, premature fishplate and rail wear, and fractured rails, fishplates and bolts. Always grease fishplates when fitting.

Note that fishplates for 20-25-301b/yd BS 11 (Old) rail usually have oval holes. Cup-oval fishbolts must be used in oval fishplate holes.

Fishplates for BS248 (Mines) rail have square holes.

Full length (4 hole) fishplates must be used for all permanent track, except for point blades where 2 or 3 hole fishplates may be required.

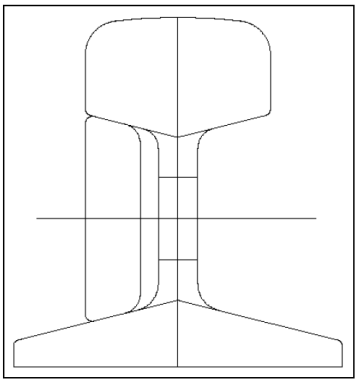


**Figure 2 : Correct Fitting of Fishplate**

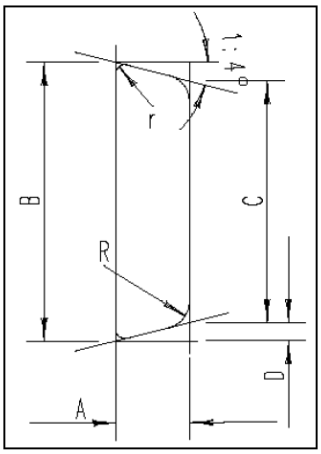



**Figure 3 : BS248 (Mines) Fishplate**

| lb/yd | A | B | C | D | R | r | Top taper | Bottom taper |
|---|---|---|---|---|---|---|---|---|
| 16M | 3/8 | 1 7/16 | 1 1/4 | 3/32 | 3/16 | 1/16 | 1:4 | 1:4 |
| 20M | 7/16 | 1 19/32 | 1 3/8 | 7/64 | 3/16 | 1/16 | 1:4 | 1:4 |
| 25M | 7/16 | 1 11/16 | 1 15/32 | 7/64 | 3/16 | 1/16 | 1:4 | 1:4 |
| 30M | 1/2 | 1 13/16 | 1 9/16 | 1/8 | 3/16 | 1/16 | 1:4 | 1:4 |
| 35M | 1/2 | 1 29/32 | 1 21/32 | 1/8 | 3/16 | 1/16 | 1:4 | 1:4 |

**Table 5 : BS248 (Mines) Fishplate Dimensions**

| lb/yd | A | B | C | D | R | r | Top taper | Bottom taper |
|---|---|---|---|---|---|---|---|---|
| 14 | | 1 3/8 | | | | | 1:5 | 1:5 |
| 20 | | 1 19/32 | | | | | 1:5 | 1:5 |
| 25 | | 1 3/4 | | | | | 1:4 | 1:4 |
| 30 | | 1 7/8 | | | | | 1:4 | 1:4 |
| 35 | | 2 1/32 | | | | | 1:4 | 1:4 |
| 40 | | 2 3/16 | | | | | 1:4 | 1:4 |
| 45 | | 2 7/16 | | | | | 1:4 | 1:4 |

**Table 6 : Fishplate Dimensions for BS 11 (Old) Rail (inches)**

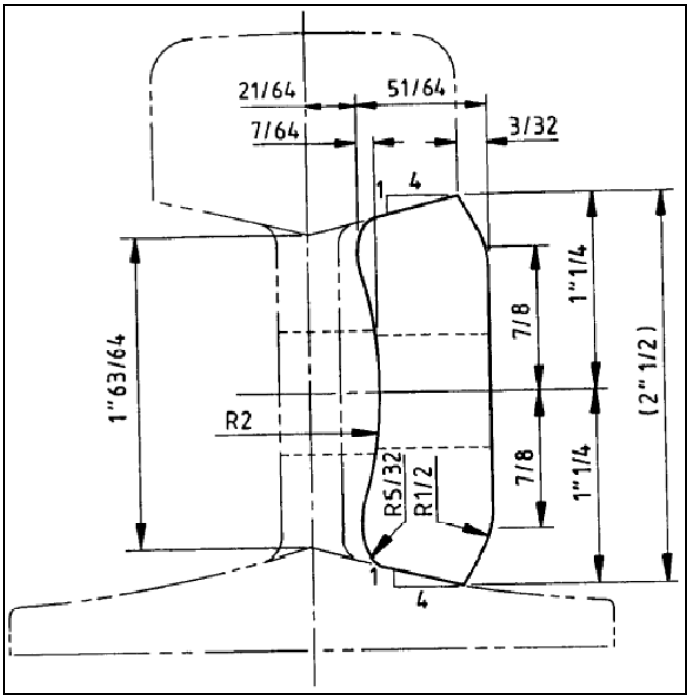



**Figure 4 : BS47 Fishplate for BS 11 (Old) 50lb/yd rail**

### 6.2:- Joggled fishplates

When joining rails of different sections (or condition), the maximum permitted height difference and lateral displacement is 1/8”. Beyond this limit, joggled fishplates must be used. Note that wear or wastage can cause more than 1/8” difference in section on the same type of rail. A matched set of 4 joggled fishplates is required for one joint. All four joggled fishplates are handed and must be fitted in the correct locations.

Fishplate shims may be fitted to compensate for small differences (less than 1/8") in rail height or head thickness, but their use must be approved by the PWE.

### 6.3:- Fishbolts

Fishbolts must be manufactured to BS325 (Black Steel Bolts and Nuts). Fishbolts must be fitted to all holes in fishplates. The threads and square under the head must be in good condition before fitting. Fishbolts must always be greased when fitting. The tightness of bolts must be checked after installation and after one month of operation.

| Rail Type | Rail Weight | Bolt Type |
|---|---|---|
| BS11 (Old) | 20-35 lb/yd | Cup-oval |
| BS248 (Mines) | 20-40 lb/yd | Cup-square |

**Table 7 : Types of Fishbolt**

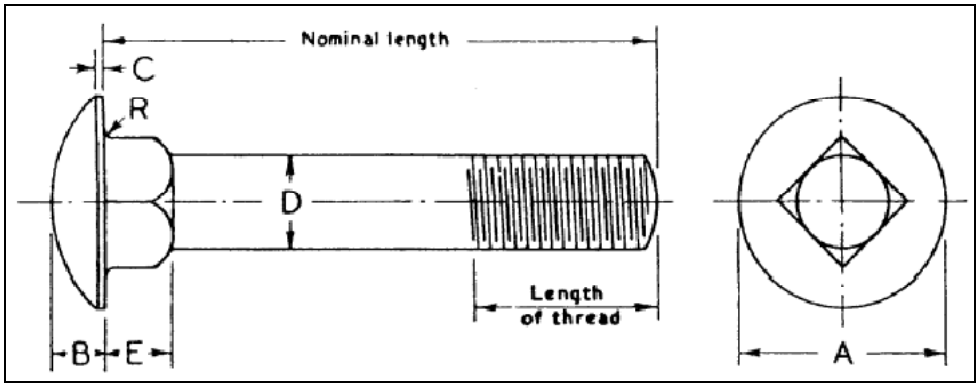



**Figure 5 : BS325 Cup-Square Fishbolt**

| Rail weight lb/yd | Dia. BSW | Nominal length | Thread length | Depth of square |
|---|---|---|---|---|
| 14 | $^{3}/_{8}$ | $1^{3}/_{4}$ | 1 | $^{9}/_{32}$ |
| 20 and 25 | $^{1}/_{2}$ | 2 | $1^{1}/_{4}$ | $^{3}/_{8}$ |
| 30 and 35 | $^{5}/_{8}$ | $2^{1}/_{2}$ | $1^{1}/_{2}$ | $^{15}/_{32}$ |
| 40 | $^{5}/_{8}$ | 3 | $1^{1}/_{2}$ | $^{15}/_{32}$ |
| 45 and 50 | $^{3}/_{4}$ | $3^{1}/_{2}$ | $1^{3}/_{4}$ | |

**Table 8 : Fishbolt Dimensions (inches)**

Note that M16 fishbolts with hexagon nuts may be used in place of 5/8” BSW with square nuts. However it is not permitted to mix M16 and 5/8” BSW fishbolts at the same rail joint. Great care must be taken to avoid mixing metric and imperial nuts.

### 6.4:- Fishbolt hole sizes in rail

Fishbolt holes must be drilled in the rail ends. Never use a flame cutter. See the tables for locations and sizes.

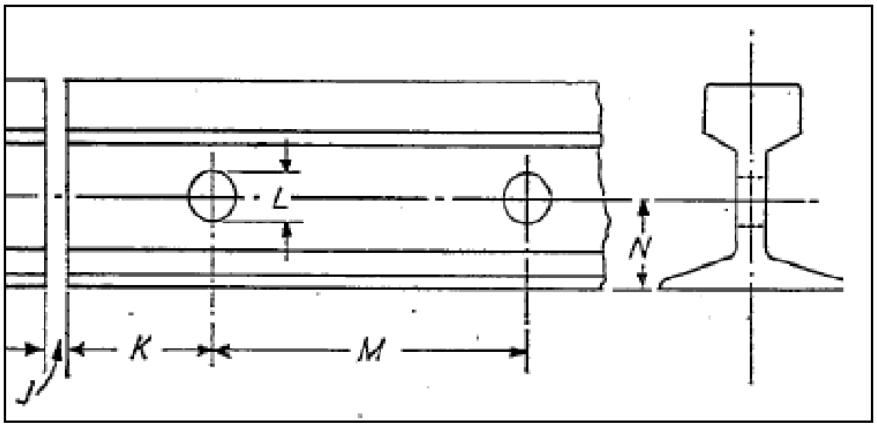



**Figure 6 : Bolt Holes in End of Rail**

| | Holes in Rail | | | | | |
|---|---|---|---|---|---|---|
| lb/yd | J | K | L | M | N | Bolt |
| 16M | 1/4 | 1 5/8 | 1/2 | 3 1/2 | 31/32 | 3/8 |
| 20M | 1/4 | 1 5/8 | 5/8 | 3 1/2 | 1 1/8 | 1/2 |
| 25M | 1/4 | 1 5/8 | 5/8 | 3 1/2 | 1 13/64 | 1/2 |
| 30M | 1/4 | 1 5/8 | 3/4 | 3 1/2 | 1 5/16 | 5/8 |
| 35M | 1/4 | 1 5/8 | 3/4 | 3 1/2 | 1 11/32 | 5/8 |

**Table 9 : BS248 (Mines) Bolt Hole Locations in End of Rail (inches)**

| | Holes in Rail | | | | | |
|---|---|---|---|---|---|---|
| lb/yd | J | K | L | M | N | Bolt |
| 14 | 1/4 | 1 5/8 | 5/8 | 3 1/2 | | 3/8 |
| 20 | 1/4 | 1 5/8 | 3/4 | 3 1/2 | | 1/2 |
| 25 | 1/4 | 1 5/8 | 3/4 | 3 1/2 | | 1/2 |
| 30 | 1/4 | 1 5/8 | 13/16 | 3 1/2 | | 5/8 |
| 35 | 1/4 | 1 5/8 | 13/16 | 3 1/2 | | 5/8 |
| 40 | 1/4 | 1 5/8 | 7/8 | 3 1/2 | | |
| 45 | 1/4 | 1 7/8 | 15/16 | 4 | | |
| 50 | 1/4 | 1 7/8 | 15/16 | 4 | 1 81/128 | |

**Table 10 : Bolt Hole Locations in End of Rail for BS 11 (Old) (inches)**

## 7:- Portable track

BS536 portable track (Jubilee) is constructed from 20lb/yd rail in panels 18ft long with 6 sleepers per panel, type 11lb/yd, secured with RC clips and cup-sq. bolts.

## 8:- Sleepers

### 8.1:- Wooden sleeper sizes

Wooden sleepers must be used on the main running lines. The preferred section for wooden sleepers is 200mm wide (minimum) x 130mm thick (minimum). Good quality mainline type sleepers 10” wide or crossing timbers 12" wide may also be used. Sleepers of different sizes must not be intermixed. Wooden sleepers must be 1200mm long minimum. The preferred timber is Larch or Douglas Fir. All softwood sleepers must be pressure treated with a suitable preservative. Where sleepers are cut, the ends must be treated with preservative.

### 8.2:- Sleeper condition

Sleepers must be replaced when they are no longer strong enough to retain the rail fixings (spikes or chair screws). It is sometimes possible to extend the life of a sleeper by re-drilling and inserting the spike or chair screw in a sound section of timber. The condition of sleepers on curves is particularly important as the fixings

have to maintain the gauge and prevent rail over-turning. To avoid premature replacement, sleepers which are already showing evidence of rot must not be laid on permanent track, whether main lines or sidings.

### 8.3:- Storage of wooden sleepers

Wooden sleepers must stacked with space between them for air to circulate. This will minimise the tendency to rot.

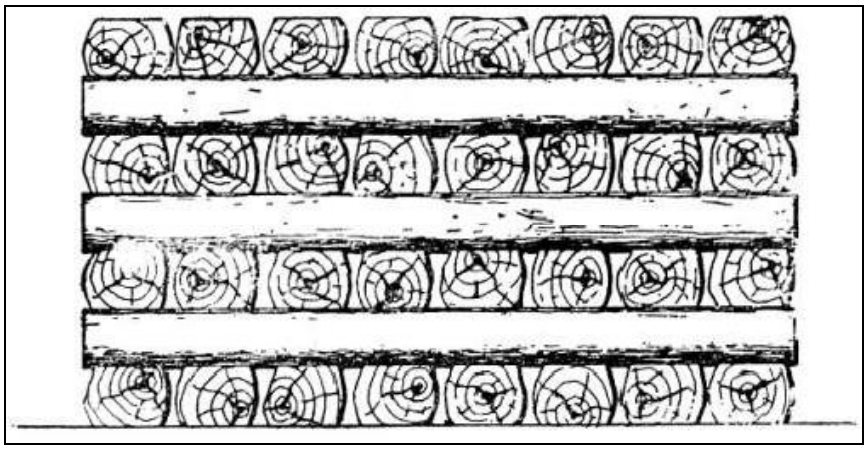


**Figure 7 : Stack of sleepers**

### 8.4:- Location of sleepers

Do not locate wooden sleepers between steel sleepers. Avoid locating sleepers directly under rail joints.

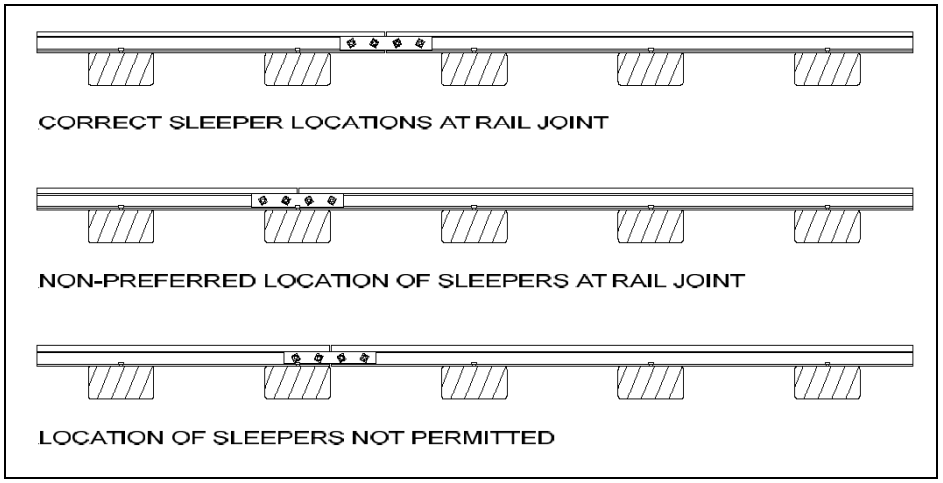



**Figure 8 : Correct and incorrect location of sleepers at a rail joint**

### 8.5:- Sleepers for turnouts

Ensure that all baseplates (and steel sleepers) are supported by wooden sleepers. Do not locate wooden sleepers between steel sleepers on plain line.

Ensure that point blades, especially the ends, are adequately supported by steel baseplates or steel sleepers.

Where pre-fabricated turnouts have trough or corrugated type sleepers, intermediate wooden sleepers are unavoidable. This type of turnout is non-preferred and must not be used on passenger lines.

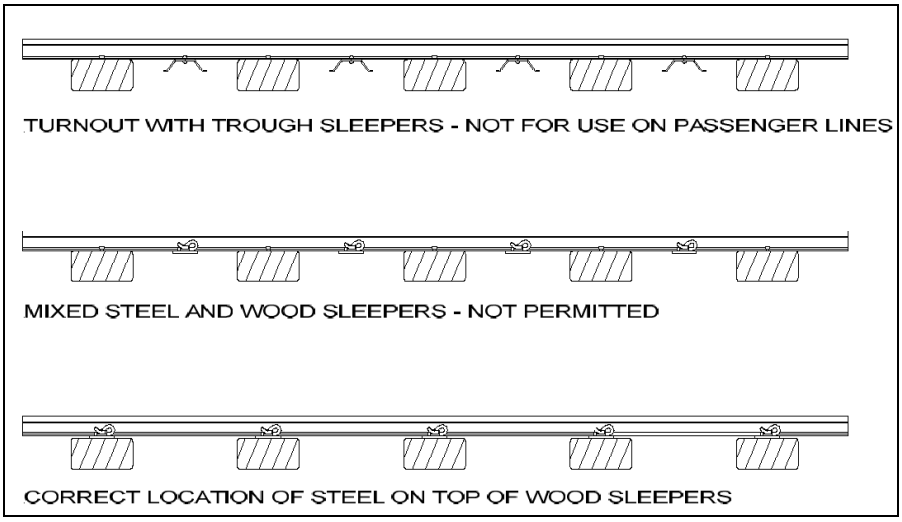



**Figure 9 : Location of Steel Sleepers**

### 8.6:- Steel sleepers

Several types of steel sleeper are available:

| Type | Rail Weight | Typical Application |
|---|---|---|
| BS536 corrugated | 20 lb/yd | Light portable/demonstration track |
| Trough | 30 lb/yd | Temporary |
| Top Hat | 30-35 lb/yd | Heavy Portable Track |
| Flat | 30-35 lb/yd | Prefabricated points<br>Heavy portable track<br>Suitable for permanent as shown above |

**Table 11 : Steel Sleepers**

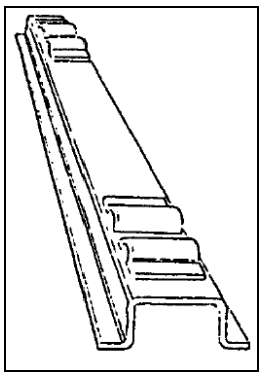


**Figure 10 : Steel Top Hat Sleeper**

Do not mix steel and wooden sleepers because tamping is impossible as there is inadequate access to the ballast. Put the wooden sleepers under flat steel sleepers.

Flat steel sleepers may be used as a temporary measure to hold gauge but must be removed or placed on top of wooden sleepers at the first opportunity.

Avoid frequent changes from wooden to steel sleepers.

## 9:- Rail Fastenings

### 9.1:- Spikes

Dogspikes (Clydesdale double eared or single eared brobs) may be used with wooden sleepers according to the following guidelines. Holes must be drilled in the sleeper prior to insertion of the spikes.

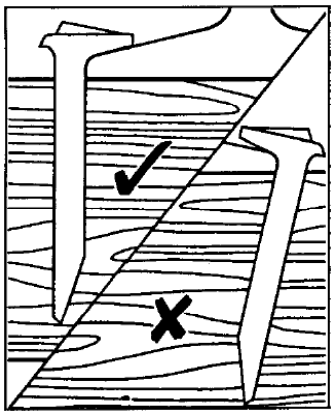


**Figure 11 : Spike Insertion**

Holes must be drilled vertically. Spikes must not be driven into the sleeper at an angle. Always run a small quantity of creosote (or permitted substitute) into the hole in the sleeper before inserting the spike.

| Rail weight | Spike Dimensions | Drill Diameter |
|---|---|---|
| 30 lb/yd | $3\frac{1}{2}$" x $\frac{1}{2}$" | $\frac{5}{16}$" |
| 20 lb/yd | $3\frac{1}{2}$" x $\frac{3}{8}$" | $\frac{3}{16}$ " |

**Table 12 : Length of Spikes**

### 9.2:- Coach Screws and Rail Clips

1/2" (12mm) x 4" (100mm) coach screws and rail clips may be used as an alternative to track spikes. 3/8"" (10mm) holes should be drilled in the sleeper. Always run a small quantity of grease into the hole in the sleeper before inserting the screw. Rail clips should be positioned so that they lie flush against the sleeper with the step in the clip being used to grip the rail.

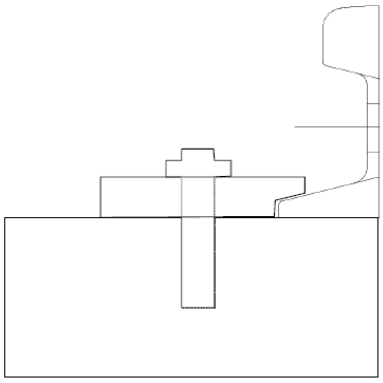


**Figure 12 : Use of coach screws and rail clips**

### 9.3:- Location of fastenings on wooden sleepers

To avoid splitting the sleeper, stagger the fastenings.

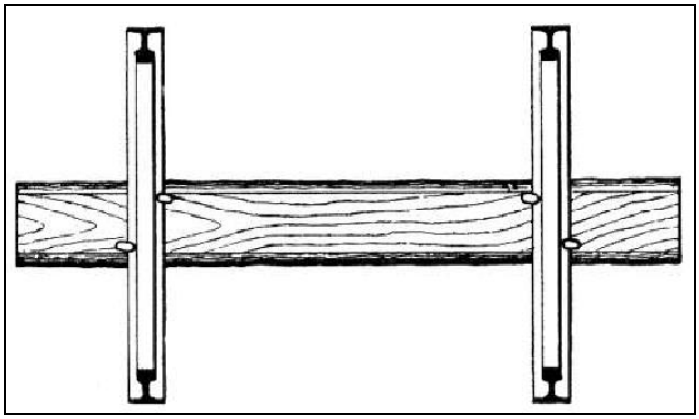


**Figure 13 : Staggered fastenings in a wooden sleeper**

### 9.4:- Track clips (Pandrol & bolted)

Flat sleepers can be fitted to use Pandrol PR type clips.

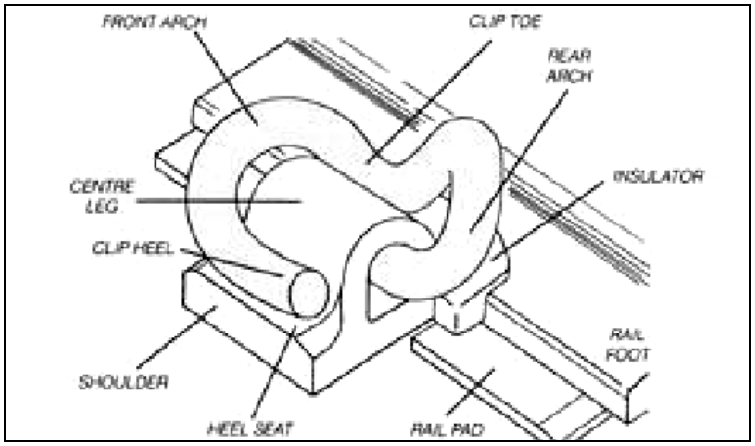



**Figure 14 : Pandrol PR Clip**

BS536 portable track and some older turnouts with corrugated type sleepers use RC bolted clips. Clip bolts must be manufactured to BS325 (Black Steel Bolts and Nuts).

| Rail weight | Clip | Bolt |
|---|---|---|
| 20 and 25 lb/yd | No. 5 rail clip | $\frac{1}{2}$ " BSW x $1\frac{1}{4}$ " cup |
| 30 and 35 lb/yd | No. 6 rail clip | $\frac{5}{8}$ " BSW x $1\frac{1}{2}$ " cup |

**Table 13 : Track Clips**

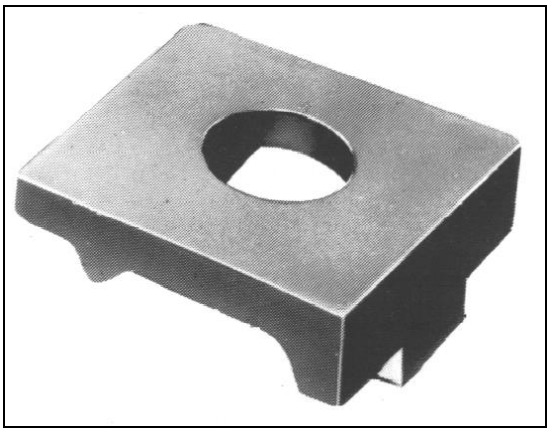


**Figure 15 : RC Clip**

## 10:- Ballast

### 10.1:- Ballast standard

Ballast must be clean and sized between 1" and 2 ½" Stone must be broken and angular. Rounded pebbles are not acceptable. Ballast must be granite or limestone. Sandstone is not suitable. Ensure that the ballast does not contain fines.

### 10.2:- Ballast depth

When fully packed, there must be 3" to 6" of ballast below the bottom of the sleeper.

### 10.3:- Packing & tamping

Track must initially be laid on a thin layer of ballast. Additional ballast up to the sleeper top must be added. The track must then be lifted and stone packed under the sleepers to achieve the correct level. Additional ballast may be added to compensate for that used during packing.

New track must be inspected after 1 month and re-packed as required. Speed must be limited to walking pace over newly laid or packed track until inspected and passed for normal running.

Note that packing of ballast must be concentrated under the rail seats and the ends of the sleepers, not in the centre.

Steel sleepered track without wooden sleepers must be laid with a small ballast void along the track centre line. The ballast must be concentrated under the rail seats. This will avoid bent sleepers.

Do not infringe minimum horizontal and vertical clearances to structures and do not damage services (water pipes, buried cables, drains etc.) when packing the track.

**10.4:- Use of Kango Hammers**

Before using Kango hammers, inspect the equipment and check for damage to the electrical cables and loose bolts. Check that the equipment has been lubricated in accordance with the manufacturer's instructions. Ear defenders and eye protection must be used. Prolonged operation of Kango hammers can lead to "white finger". Anti-vibration gloves may help.

**DO NOT use a kango hammer for more than One Hour continuously. STOP if you feel any symptoms of White Finger, which include:-**

- **Fingers turning white and cool.**
- **Tingling/pins and needles sensations in fingers.**
- **Numbness in fingers**

Jack the rail up to the correct level. Always use Kango hammers in pairs, working on opposite sides of the same sleeper end. Pack the ballast under the rail seats and towards the sleeper ends. Do not lift or lower the jacks when removing them as this will disturb the new packing. Ease the jacks out from under the rail.

**10.5:- Excessive ballasting**

Excess ballast causes rail corrosion and rotting of sleepers. The top of the ballast must be no higher than ½” below the sleeper top. Ballast must not be left lying on top of the sleepers. A gap of at least 20mm must be left between the top of the ballast and the foot of the rail. This is to allow the passage of great crested newts.

Ballast must not be allowed to enter check or wing rail gaps, or anywhere within 6" of point blades. The point lever mechanism, rodding and tiebar must be kept free of ballast. There must be at least 3" clearance between the top of the ballast and any point rodding or tiebar.

**10.6:- Keep ballast clean**

Ballast must be clean when laid and must be kept clean thereafter. Fouled ballast prevents drainage and results in rotten sleepers. In addition, packing track with fouled ballast does not produce a stable formation. Do not allow ash from locomotives to fall on the ballast. Always ash out steam locos in a designated location. Remove all ash from the track and dispose of it correctly. Do not allow earth, clay or rubbish from excavations to fall onto the ballast when loading or unloading wagons.

## 11:- Turnouts

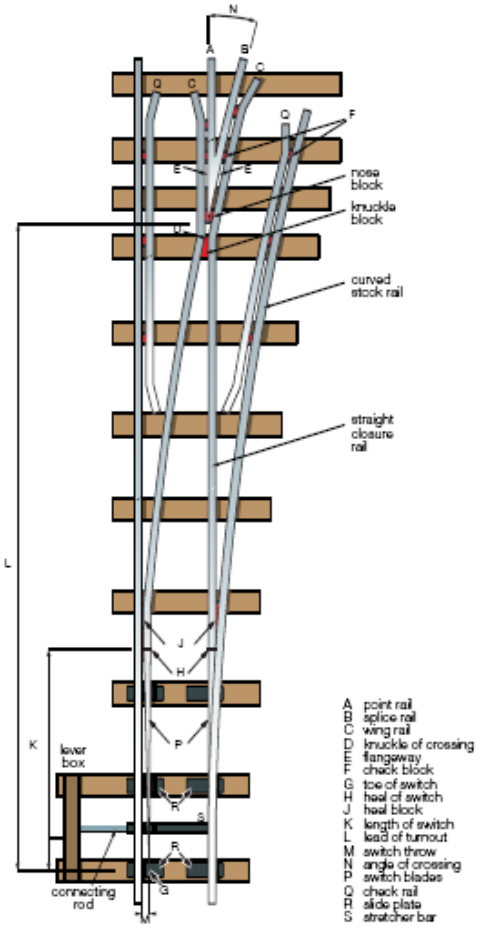



**Figure 16:- Turnout component names**

### 11.1:- Crossing angles

Turnouts on main running lines (and also loops wherever possible) must have 1:4.5 or shallower crossings. Locomotive and carriage shed roads must use 1:4 or shallower crossings. Turnouts with 1:3 crossings (and shorter) must only be used for access to sheds and sidings for smaller vehicles.

### 11.2:- Definition of crossing angle

The crossing angle is defined as the distance across the ends of the vee rails (the point and splice rails) divided by the length from the crossing nose to the point rail end.

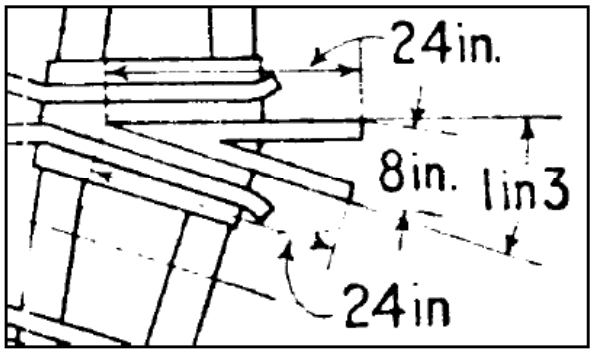



**Figure 17 : Crossing Angle**

### 11.3:- Turnout radii

| Crossing Angle | Maximum Radius |
|---|---|
| 1:5 | 100 ft |
| 1:4.5 | 80 ft |
| 1:4 | 65 ft |
| 1:3 | 37 ft |
| 1:2.5 | 25 ft |

**Table 14 : Turnout Radii**

### 11.4:- Standard turnouts

Many older turnouts conform to BS536. Note that BS536 applied only to 14lb/yd and 20lb/yd rail, but the dimensions were frequently used for 30lb/yd turnouts with steel sleepers.

| Crossing Angle | Radius | Length |
|---|---|---|
| 1:4 | 65 ft | 18 ft |
| 1:3 | 37 ft | 15 ft |

**Table 15 : BS536 Turnouts**

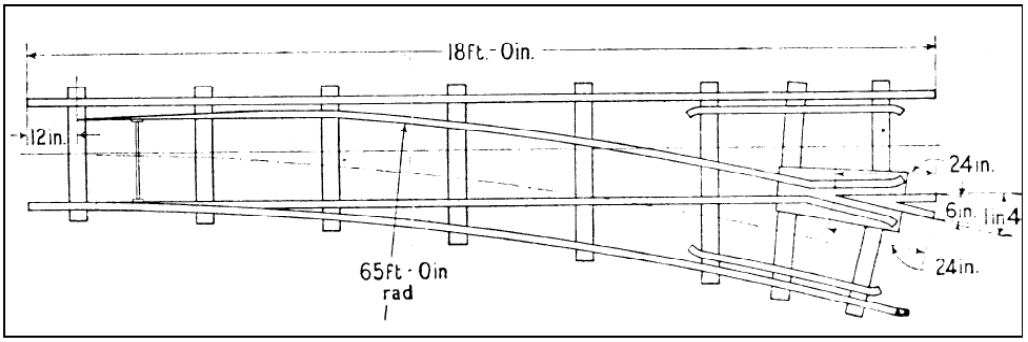



**Figure 18 : BS536 1:4 Turnout**

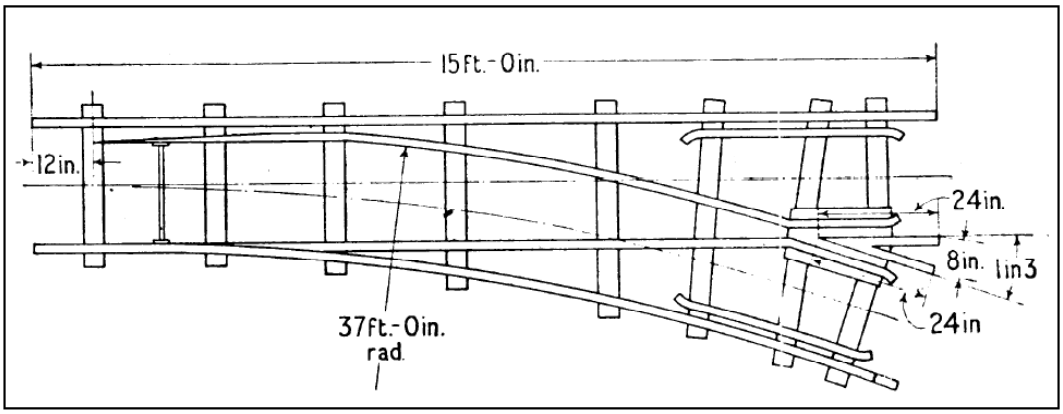



**Figure 19 : BS536 1:3 Turnout**

### 11.5:- Check blocks

Check blocks must be used for checkrails on turnouts. A standard design is available for 30 lb/yd and 35 lb/yd rail.

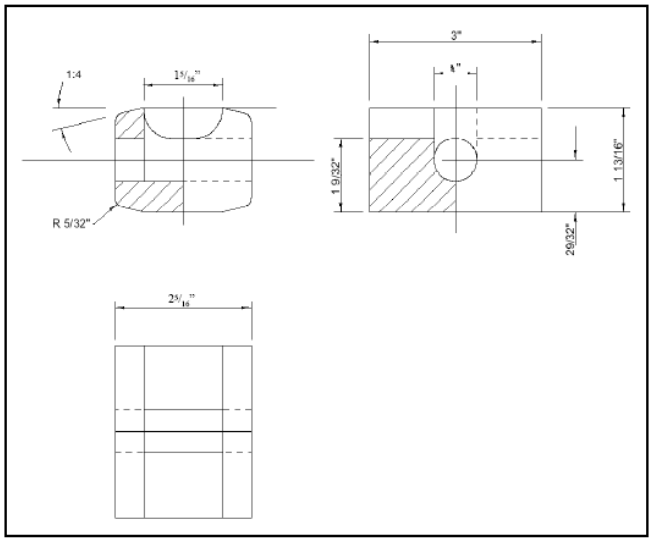



**Figure 20 : Check Block**

Check blocks are also used on turnouts with sprung blades.

### 11.6:- Check rail gap

The check rail gap must be 1 3/8” minimum to 1 ½” maximum. This means that the minimum wheelset back-to-back is 24” minus (2 x 1 3/8”) = 21 ¼” (see MRTSP23). Note that BS536 specifies the check rail gap as 1 3/16” for turnouts constructed with 14lb/yd or 20lb/yd rail. This gap is not adequate for general use. However, when turnouts are built with 30lb/yd or 35lb/yd rail, the check rail gap is normally 1 3/8”.

Note that suitable allowance should be made for gauge widening on tightly curved points. For example, if the gauge is widened by ½”, and check rail gaps are set to 1 3/8”, then the back-to-back dimension will be constrained to 24 ½” minus ( 2 x 1 3/8”)

= 21 ¾". A wheelset with a standard back-to-back of 21 ¼" will foul the checks in such a circumstance.

The key dimension to achieve is to permit a back-to-back of 21 ¼" to traverse the points, and this takes precedence over the stated check rail gaps; if adjustments are needed, these should be carried out at the wing rail rather than the check rail – since the check rail has to act to "protect" the crossing nose from a wheelset going "wrong side".

Experience has shown that it is desirable for the check rail gaps to be at the higher end of the tolerance band.

**11.7:- Check rail lead in**

Check rails require a lead-in, width 2 ¾" minimum, length 10" min.

**11.8:- Turnout blade throw**

The turnout blade throw (at the tip of the blade) must be 3" +/- ¼""

**11.9:- Turnout blade pivots**

Turnouts with crossing angles 1:6 to 1:8 must not use hinged blades; the rail must spring.

Hinged blade turnouts may NOT be used on passenger running lines – only spring blade turnouts may be used. [1]

Turnouts with 1:5 or 1:4.5 crossing angle may use hinged or spring blades.

Blades on turnouts with crossing angles 1:2 to 1:4 must be hinged.

Hinged blades are to be attached using fishplates with locknutted fishbolts. Only one hole pitch of the fishplate may be connected to the blade. The fishbolts must be adjusted so that the blade is free to pivot but without allowing excessive sideways deflection at the joint.

**11.10:- Tiebars**

Hinged blades must have pivoted tiebars. Pivot bolts must have locknuts or self-locking nuts. Sprung blades may use solid tiebars but they must be sufficiently flexible. Attachment bolts for sprung blade tiebars must use self-locking nuts or spring washers.

**11.11:- Turnout operating levers**

Turnout levers are classed as either weighted or spring types.

Weighted levers may only be used for hinged point blades.

[1] Ref RSP5 clause 73.

### 11.12:- Lever Frames

Lever (ground) frames, typically with one operating and one locking lever, must be located where the operator has a clear view of the tracks and turnouts to be controlled. Train crew must be able to see the operator's hand signals.

The locking lever must be interlocked with the operating lever. The locking lever must be provided with a keyed locking device to prevent unauthorised movement.

The locking table on a lever frame must be kept well lubricated to ensure the free movement of the locking tappets, cams and lever shoes. The locking table cover should be properly secured.

NOTE:- The design of interlocking devices for anything other than the most simple application is a highly specialist task, and advice must be taken where needed.

### 11.13:- Facing Point locks (FPL) and rodding

Facing Point locks are required on all facing turnouts on passenger lines. The locking mechanism may either be lever operated or hand operated at the turnout. The locking system must have provision (locally or at the lever) for the application of a keyed lock.

Detection rodding between the blades and the lock must be direct and completely independent of the operating mechanism. The detection rodding must be attached as close to the toe of the blade as possible.

Cranks and FPLs must be attached to suitable foundations that will not move relative to the turnouts or lever frame. A check should also be made to ensure that there is no undue movement in timbers supporting a crank or point lock when the rodding connected to it is worked. Cranks should be fitted with grease nipples and greased annually.

All FPLs must be set so that when a 1/8” thick gauge is placed between the blade and stock rail next to the FPL detection rod, the FPL cannot be operated.

Rodding must be provided with adjustment to allow for minor re-alignment or settlement of tracks. Adjustment screws must be fitted with locknuts. The rodding must be adjusted so that there is less than 1/8” gap between the turnout blade and the stock rail. The gaps must be checked with the turnout set for both the main line and the diverging route. Where two turnouts are linked by rodding, e.g. a crossover, the gaps at both ends of the crossover must be checked.

Turnout operating rodding parallel to the track should not be closer than 2ft 6in to the nearest running rail. Rodding runs should be checked for wear in the pins, joints, bushes and loose roller stools to ensure loss of travel is kept to a minimum.

All bolts and pivot pins used on FPLs, rodding, cranks and lever frames must be fitted with split pins.

### 11.14:- Bolts, nuts and washers for turnouts

Bolts for turnouts (except fishbolts) must be grade 8.8 (stamped on the head).

Spring washers or self-locking nuts must be used for all bolts except fishbolts. Where spring washers are used, ensure that the bolt hole is small enough for the washer tang to engage on the face of the component. If the hole is too large, use a flat washer under the spring washer.

If a spring washer or self-locking nut is used, there must be at least 1 1/2 threads exposed beyond the nut.

Where bolts are not at right angles to the rail web, e.g. crossing bolts, taper washers must be used under the bolt head and the nut.

Bolts used on pointwork should be of adequate diameter. For 30lb/yd and 35lb/yd they should be 5/8”" BSW, or M16 on modern turnouts.

## 12:- Track Laying

### 12.1:- Setting out curves

Curves may be set out by radius and length, or by offsets from a projected string line. The method is generally determined by whether the curve will join existing sections of track together. Always refer to the drawing.

### 12.2:- Curve templates

It is recommended that templates should always be used when bending rails. A fixed (wooden) template must be used for standard 37ft radius curves. An adjustable template is to be used for other radii. The template may only be adjusted using instructions issued by the PW Engineer.

### 12.3:- Rail bending

For curves less than 200ft radius, rails must be bent using a jim-crow rail bender. Use a jim-crow of suitable size for the rail section. Rails must be bent at intervals of less than 12".

The preferred method is to apply a slight bend at half jim-crow pitches, i.e. by marking with chalk and moving the jim-crow half its length per bend, check using the template, then to follow this up with another series of bends exactly half way between the first set. The cycle is repeated until the required radius is achieved.

To ensure that each bend is exactly the same deflection, hand tighten the screw up to the rail and put a chalk mark on top. Always apply the same angle of turn to the screw as shown by the rotation of the chalk mark.

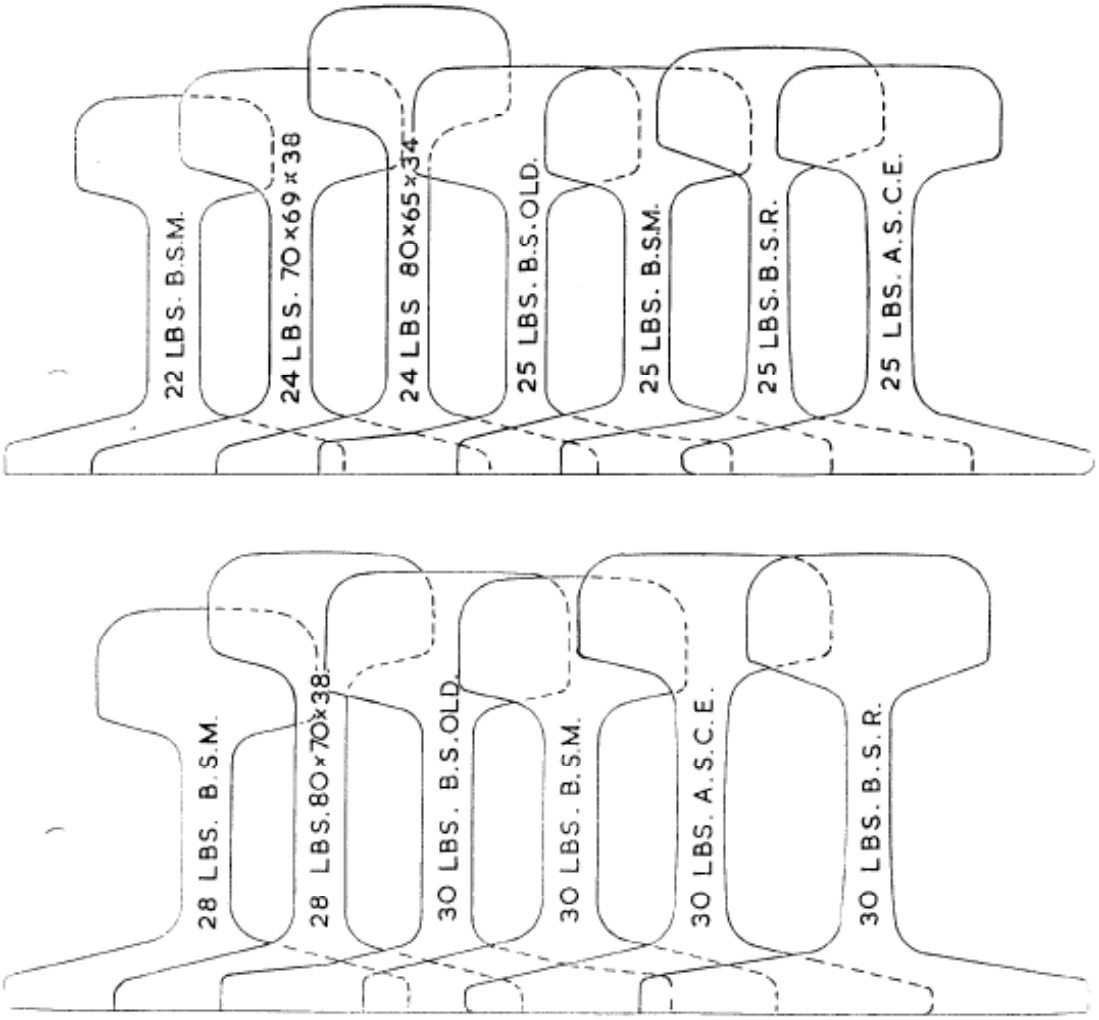
### 12.4:- Flame cutting and welding problems

Flame cutting of rails and burning of fishbolt holes are prohibited. Rails must be cut using a mechanical hacksaw or grinding disc. Holes must be drilled, not flame cut.

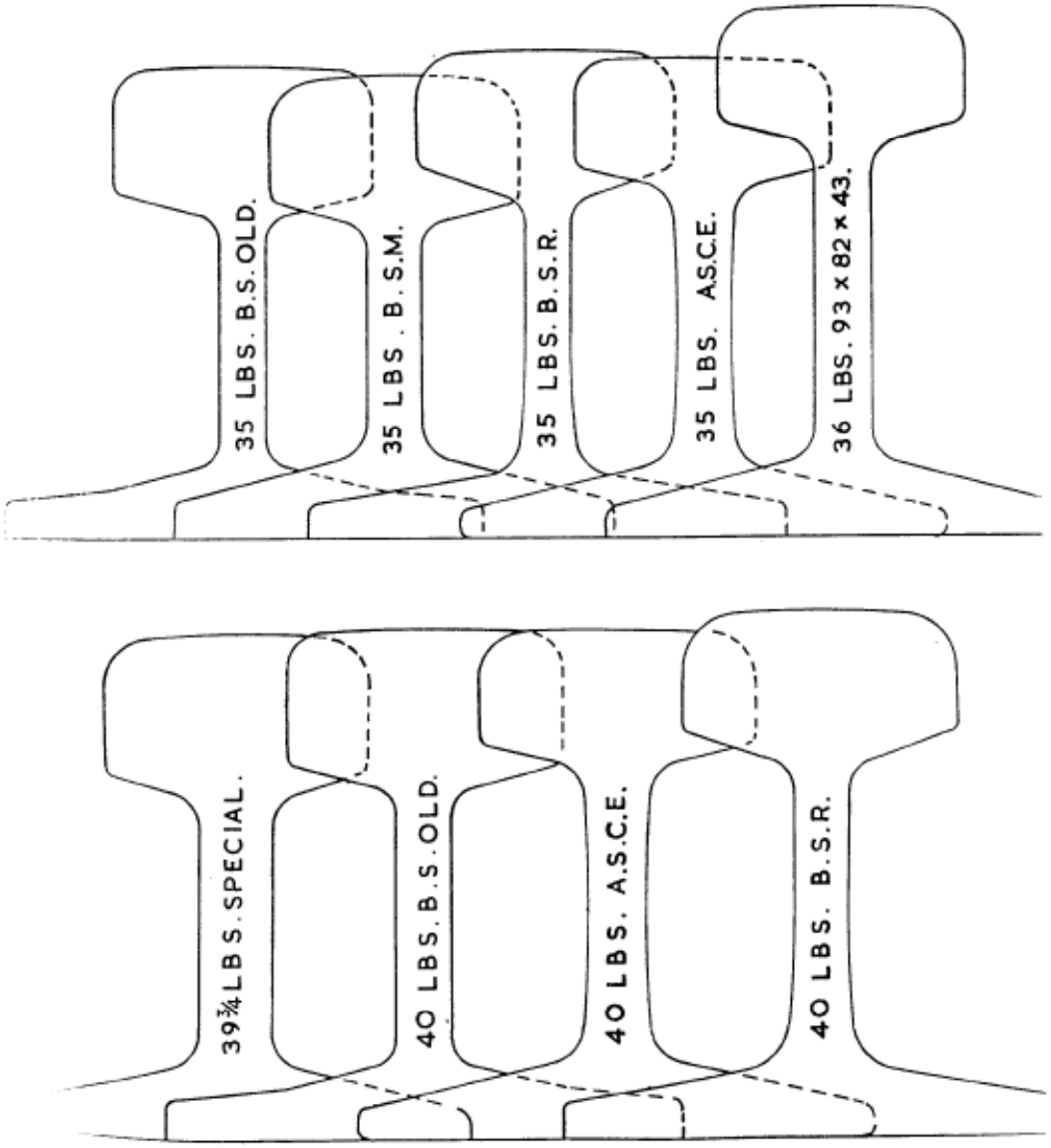
Rails must not be welded without permission of the PWE.

These restrictions apply because of thermal damage which can result in broken rails.

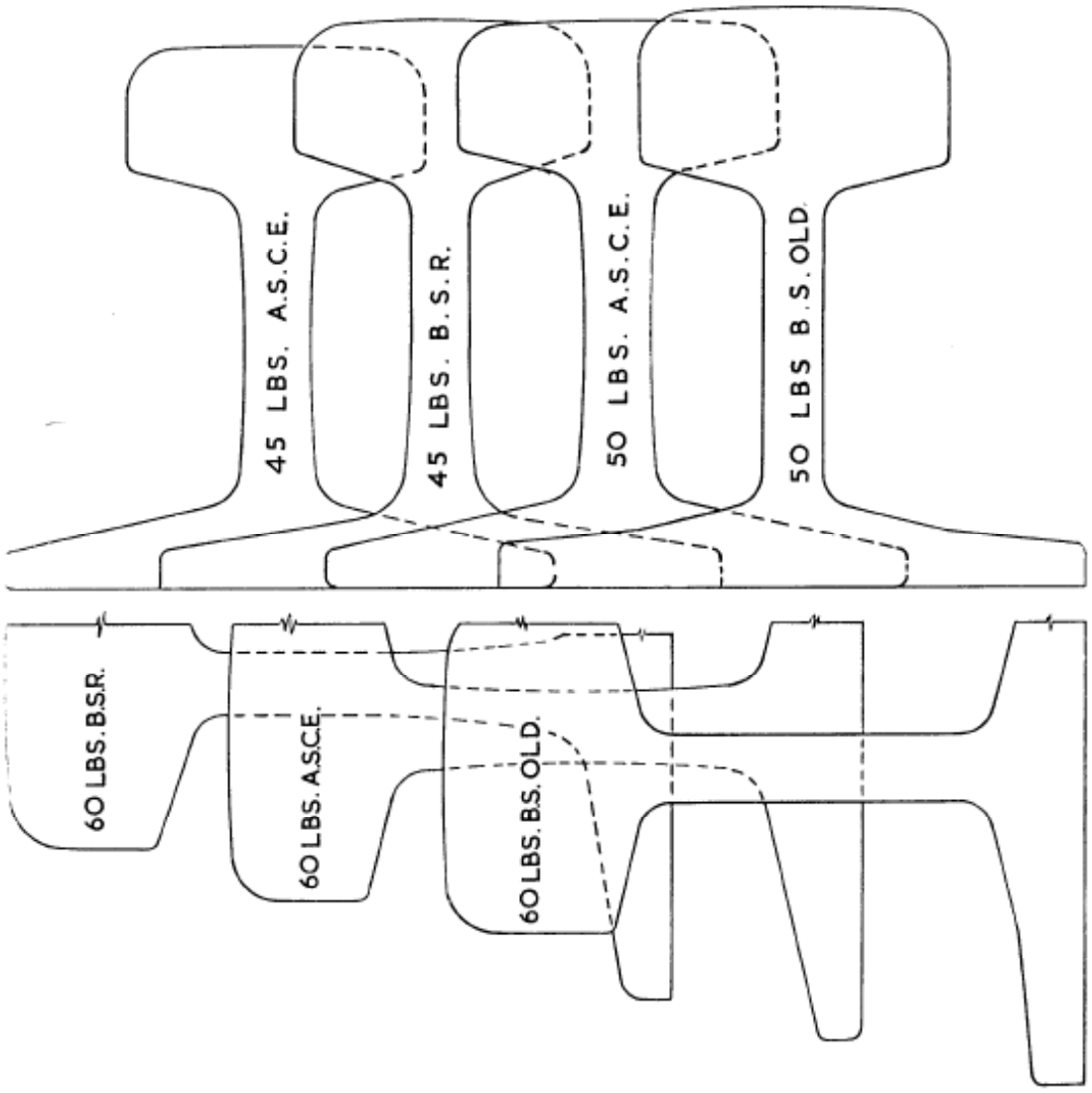
## Appendix B:- Rail Sections




**Rail Sections 22 to 30 lb/yd**




## Rail Sections 35 to 40 lb/yd




**Rail Sections 45 to 60 lb/yd**