Rail Traffic Loading Requirements for the Design of Railway Structures

Synopsis
This Railway Group Standard sets out the minimum rail traffic loading requirements to be considered in the design of new, reconstructed, altered, and temporary railway structures.

Content approved by:
Infrastructure Standards Committee on 17 September 2008

Published by:
Rail Safety and Standards Board
Evergreen House
160 Euston Road
London NW1 2DX

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Issue record

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| Two   | December 2008 | Replaces issue one.  
|       |            | Now incorporates extension in scope from ‘bridges’ to ‘all railway structures’, reduction in scope from ‘all loads’ to ‘railway traffic loads’ and amendments to allow a transitional change from compliance with BS5400-2:2006, until it is withdrawn by BSI, to compliance with BS EN 1990:2005(A1) - Annex A2 and BS EN 1991-2:2003 (parts of the suite of Structural Eurocodes). |

Revisions have not been marked by a vertical black line in this issue because the document has been revised throughout.

Superseded documents

The following Railway Group documents are superseded, either in whole or in part as indicated:

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GC/RT5112 Issue 1 ceases to be in force and is withdrawn as of 07 February 2009.

GC/RC5510 Issue 2 is withdrawn as of 07 February 2009.

Supply

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Part 1  Purpose and Introduction

1.1  Purpose

1.1.1  This Railway Group Standard sets out the minimum rail traffic loading requirements to be considered in the design of new, reconstructed, altered, and temporary railway structures.

1.2  Introduction

1.2.1  Development of codes for the design of railway structures

1.2.1.1  Non-mandatory background information on the development of loading standards for the design of railway bridges is set out in 1.2, which sets the scene for the revision of GC/RT5112.

1.2.1.2  GC/RT5112 Issue 1 was based on the loading requirements that are specified in the Highways Agency design document BD 37/88 ‘Loads for Highway Bridges’. BD 37/88 was developed by the former Department of Transport to provide an update for the highway loading requirements within BS 5400-2:1978 ‘Steel, concrete and composite bridges – Part 2: Specification for loads’. As the replacement for BS 5400-2:1978, BD 37/88 was also adopted by the former British Rail.

1.2.1.3  BS 5400-2:2006 ‘Steel, concrete and composite bridges – Part 2: Specification for loads’ incorporates the design requirements in BD 37/88; includes the revisions contained within the update to BD 37/88 (BD 37/01); and additionally updates certain aspects of railway loading. It will remain as the UK’s national standard for railway loading until it is withdrawn by the British Standards Institution (BSI) (currently expected to be March 2010).

1.2.1.4  Once the relevant Eurocodes are available, railway bridges can be designed to them. The design requirements for railway loading in BS 5400-2:2006 will be replaced by BS EN 1991-2:2003 ‘Traffic Loads on Bridges’ and BS EN 1990:2005(A1) – Annex A2 ‘Basis of structural design – Application for Bridges’. Annex A2 contains the rules for combination of railway loads, the values of the combination factors ($\psi$), the values of the load factors ($\gamma$), and criteria for deformation and vibration.

1.2.1.5  Implementation of the European Directive covering procurement procedures for public bodies in the transport sector (Directive 2004/17/EC) will require publicly funded works to be designed to the Structural Eurocodes once the national standards are withdrawn. Directive 2004/17/EC is implemented in the UK through the Utilities Contracts Regulations 2006 and the Utilities Contracts (Scotland) Regulations 2006.

1.2.2  Revision of GC/RT5112 – design codes

1.2.2.1  To cover the situation where railway bridges can be designed to the current national standard for loading, and to permit the use of the Structural Eurocodes, both BS 5400-2:2006 and BS EN 1991-2:2003 are included within this revision of GC/RT5112.

1.2.2.2  GC/RT5112 has been revised to require the use of either BS 5400-2:2006, or BS EN 1991-2:2003 plus BS EN 1990:2005(A1) – Annex A2 ‘Basis of structural design – Application for Bridges’, until such time as BS 5400-2:2006 is withdrawn.
1.2.3 Revision of GC/RT5112 – loads and load effects

1.2.3.1 There are a number of railway loading aspects that were not covered in any detail within GC/RT5112 issue 1. These loads and load effects are specifically addressed in this revision. They are:

a) Dynamic effects (acceleration and risk of resonance)

b) Effects of repeated loading (fatigue)

c) Actions due to traction and braking

d) Nosing forces

e) Centrifugal forces

f) Deformations (including track twist)

g) Aerodynamic actions

h) Derailment actions

i) Actions due to surcharge from railway traffic on earth embankments.

1.2.4 Revision of GC/RT5112 – types of structure

1.2.4.1 The scope of GC/RT5112 has been extended to include all structures subject to railway loading including:

a) Bridges.

b) Structures (other than bridges) that support the railway (for example retaining walls, tunnel inverts, buried structures, earth embankments).

c) Structures adjacent to or above the railway (for example bridge supports, station roof canopies, buildings, road bridges, footbridges and signal gantries).

1.2.4.2 In the case of structures adjacent to or above the railway, the scope is limited to derailment and aerodynamic actions.

1.2.4.3 The requirements for design of structures for aerodynamic actions are set out in 6.1.1.1.

1.2.4.4 The requirements for design of structures for derailment actions are set out in 7.1.1.1.

1.2.5 Related requirements in other documents

1.2.5.1 GE/RT8006 ‘Interface between Rail Vehicle Weights and Underline Bridges’ sets out the requirements for managing the risk of overloading of underline bridges by railway vehicles.
Part 2 Design of new bridges to carry rail traffic (design to BS 5400-2:2006)

2.1 Load requirements for design

2.1.1 General

2.1.1.1 This section sets out loading requirements applicable to railway bridges designed in accordance with BS 5400-2:2006.

2.1.2 New and reconstructed bridges

2.1.2.1 Bridges carrying rail traffic operating at speeds up to and including 125 mph (200 km/h), shall generally be designed for full RU loading as specified in BS 5400-2:2006 ‘Steel, concrete and composite bridges – Part 2: Specification for loads’.

2.1.2.2 The load model for RU loading specified in clause 8.2.1.1 of BS 5400-2:2006 shall be used.

2.1.2.3 The requirements for application of a dynamic factor shall be as set out in clause 8.2.3.1 of BS 5400-2:2006.

2.1.2.4 The rules for application of the load model for RU loading to the bridge superstructure shall be as set out in clause 8.2.6.2 of BS 5400-2:2006.

2.1.2.5 The loads to be supported by deck plates and similar local elements shall be as specified in clause 8.2.5 of BS 5400-2:2006.

2.1.2.6 In exceptional cases, where safety is not adversely affected, lighter loading is permissible where this is sufficient for the intended rail traffic using the route.

2.1.2.7 Where lighter loading is used, the factor to be applied to the full RU loading (and if relevant SW/0 loading) shall not be less than 0.75. Where factored RU loading is used, the same factor shall be applied to:

   a) Centrifugal load
   b) Lateral loads applied to the track by trains (nosing)
   c) Longitudinal loads (traction and braking)
   d) Derailment loads.

2.1.2.8 Where lighter loading is used, concentrated loads on deck plates and similar elements shall be subject to a factor greater than or equal to 1.0.

2.1.3 Additional loading for continuous bridges

2.1.3.1 The SW/0 load model, specified in clause 8.2.1.2 of BS 5400-2:2006, shall be used for the design of continuous bridges.

2.1.3.2 The requirements for the dynamic factor to be applied to the load effects obtained from application of the SW/0 load model shall be as set out in clause 8.2.3.1 of BS 5400-2:2006.

2.1.3.3 The rules for application of the load model to the bridge superstructure shall be as set out in clause 8.2.6.3 of BS 5400-2:2006.
2.2 Deformation limits

2.2.1 Deformation limits shall be checked using a partial load factor of 1.0 applied to loading from rail traffic.

2.2.2 Bridges shall be designed so that deflections under the equivalent quasi-static rail traffic loading (that is the static rail traffic load model (for example RU or SW/0) enhanced by the dynamic factor) do not encroach on any required clearances.

2.2.3 Deformations for bridges carrying rail traffic shall be in accordance with UIC Leaflet 776-3R 'Deformation of Bridges' except as modified in 2.2.4, 2.2.5 and 2.2.6 of this document. The applicable speed range (1, 2 or 3) shall be appropriate to the design line speed.

2.2.4 Vertical deformations shall comply with the values in Table 5 of UIC Leaflet 776-3R. The notes to Figure 1 in UIC Leaflet 776-3R shall be corrected to read \( \delta_u = 0.56 L^{1.184} \) for spans between 26 m and 100 m.

2.2.5 The maximum vertical deflection and total design track twist due to rail traffic loads shall not exceed 1 in 400. The total design track twist comprises any twist which may be present in the track when the bridge is not subject to rail traffic loads, plus the twist due to the deflection of the bridge resulting from rail traffic loads. Requirements for the steepest permitted designed cant gradient and repair of track twist are set out in GC/RT5021.

2.2.6 The lateral deformation limits in section 7 of UIC Leaflet 776-3R shall be satisfied.

2.2.7 As an alternative to 2.2.3 to 2.2.6 of this document, it is permissible for the deformation limits to be based on the requirements of BS EN 1990:2005(A1) - Annex A2 (see section 3.2 of this document).

2.3 Dynamic performance

2.3.1 The acceptable dynamic performance of bridges, is generally assured by the application of the dynamic factors in Table 16 of BS 5400-2:2006 to RU or SW/0 loading, where the deflection of a bridge is within the limits given in UIC Leaflet 776-3R or BS EN 1990:2005(A1) - Annex A2 (see section 3.2 of this document) and when the maximum line speed is 125 mph (200 km/h).

2.3.2 In the following cases, excessive deck accelerations and resonance may occur:

a) Where rail traffic speed is in excess of 125 mph (200 km/h).

b) Where the combination of vehicle loading and speed is greater than assumed for RU and SW/0 loading.

c) For dynamically sensitive bridges.

In such cases a specific dynamic analysis shall be undertaken to assess the maximum peak bridge deck acceleration and the enhancement of static loading attributable to dynamic effects.

2.4 Fatigue

2.4.1 All fatigue susceptible elements of bridges subject to repeated cycles of rail traffic shall be checked for resistance to fatigue.

2.4.2 Bridges shall be designed to the requirements of clause 8.7 of BS 5400-2:2006 according to the categories of rail traffic that will use the line and the intended design life of the bridge.
2.5 Horizontal loads from rail traffic

2.5.1 Bridges shall be designed for the lateral loads applied to the track by trains (nosing). The loading requirements are set out in clause 8.2.8 of BS 5400-2:2006.

2.5.2 Where the track on a bridge has horizontal curvature, allowance for centrifugal forces, derived from the moving rail traffic, shall be made in designing the elements where appropriate. The nominal centrifugal load per track shall be determined and applied in accordance with the requirements of clause 8.2.9 of BS 5400-2:2006.

2.5.3 Provision shall be made, in the design of the bridge elements, for nominal loads due to traction and the application of brakes. The nominal longitudinal load shall be calculated and applied in accordance with clause 8.2.10 of BS 5400-2:2006.

2.5.4 Bridge abutments and similar earth retaining elements (for example wing walls and retaining walls) are subject to additional horizontal loading, due to the weight of trains distributed vertically and horizontally through the backfill, adjacent to the structure (surcharge). Abutments and similar earth retaining elements shall be designed for the requirements of clause 5.8.2 of BS 5400-2:2006. This loading can be assumed to include an allowance for dynamic effects.

2.6 Design for train derailment on the bridge

2.6.1 The design conditions to be considered (the equivalent static design loads at the ultimate limit states, the equivalent static design loads for stability, and the rules for application of loads) shall be in accordance with clauses 8.5 and 8.5.1 of BS 5400-2:2006.

2.6.2 For railway bridges, an effective means of containing a derailed vehicle on the bridge shall be provided taking account of the lower sector structure gauge defined in GC/RT5212 ‘Requirements for Defining and Maintaining Clearances’.
Part 3 Design of new bridges to carry rail traffic (design to BS EN 1991-2:2003)

3.1 Load requirements for design

3.1.1 General

3.1.1.1 This section sets out loading requirements applicable to railway bridges designed in accordance with BS EN 1991-2:2003.

3.1.2 New and reconstructed bridges

3.1.2.1 Bridges shall be designed for the loading requirements of BS EN 1991-2:2003 ‘Eurocode 1: Actions on structures – Part 2: Traffic loads on bridges.’

3.1.2.2 The rules for the combination of rail traffic loads, the values of the combination factors ($\psi$) and load factors ($\gamma$), and the criteria for deformation and resonance shall be as set out in BS EN 1990:2005(A1) – Annex A2 ‘Basis of structural design – Application for Bridges’, and the associated relevant clauses of the National Annex.

3.1.2.3 Bridges carrying rail traffic operating at speeds up to and including 125 mph (200 km/h) shall generally be designed for the static effect of vertical loading due to normal traffic, as specified for load model LM 71 in BS EN 1991-2:2003. LM 71 represents normal rail traffic and has the same scope as RU loading.

3.1.2.4 LM 71 loading shall be multiplied by the load classification factor $\alpha$. The value of $\alpha$ for normal rail traffic shall be as specified in clause NA.2.48 of the National Annex to BS EN 1991-2:2003.

3.1.2.5 The requirements for considering the effects of eccentricity due to the lateral displacement of vertical loads for LM 71 and SW/0 shall be as set out in clause 6.3.5 of BS EN 1991-2:2003.

3.1.2.6 For rail traffic speeds in excess of 125 mph (200 km/h) and for dynamically sensitive bridges, a dynamic analysis is required. The detailed requirements for determining whether a dynamic analysis is necessary shall be as set out in clause NA.2.50 of the National Annex to BS EN 1991-2:2003.

3.1.2.7 Where a dynamic analysis is required, the loading to be applied to the bridge shall be established for the individual project by taking into account the following:

   a) The maximum axle loads and spacings for Real Trains.
   b) The applicability of load model HSLM (HSLM-A and HSLM-B).
   c) Additional requirements for the application of load models HSLM-A and HSLM-B.

3.1.3 Additional loading for continuous bridges

3.1.3.1 Continuous bridges shall additionally be designed for the requirements of clause 6.3.3 of BS EN 1991-2:2003, using the SW/0 load model only.
3.2 Deformation limits

3.2.1 The general requirements for deformation of railway bridge decks shall be as set out in clause A2.4.4.1 of BS EN 1990:2005(A1) - Annex A2.

3.2.2 The requirements for vertical deformation of bridge decks shall be as specified in clause A2.4.4.2.3 (1) of BS EN 1990:2005(A1) - Annex A2.

3.2.3 The requirements for transverse deformation shall be as specified in clause A2.4.4.2.4 (2), of BS EN 1990:2005(A1). In Table A2.8, NOTE 3, the recommended values shall be used.

3.2.4 The requirements for determination of deck twist and the total track twist to satisfy traffic safety criteria, shall be as specified in clauses A2.4.4.2.2 (1) and (3P) of BS EN 1990:2005(A1) - Annex A2. Requirements for the steepest permitted designed cant gradient and repair of track twist are set out in GC/RT5021.

3.2.5 Limits for longitudinal displacement of the deck shall be as set out in clause A2.4.4.2.5 of BS EN 1990:2005(A1) - Annex A2.

3.3 Dynamic performance

3.3.1 The general requirements for vibration of railway bridge decks shall be as set out in clause A2.4.4.1 of BS EN 1990:2005(A1) - Annex A2.

3.3.2 The requirements for vertical acceleration of bridge decks shall be as set out in clause A2.4.4.2.1 of BS EN 1990:2005(A1) - Annex A2. The recommended maximum peak values for bridge deck acceleration shall be used.

3.3.3 The requirements for transverse vibration of the deck shall be as set out in clause A2.4.4.2.4 of BS EN 1990:2005(A1) - Annex A2. The recommended minimum value of natural frequency for the first mode of lateral vibration shall be used.

3.4 Fatigue

3.4.1 All fatigue susceptible elements of bridges subject to repeated cycles of rail traffic shall be checked for resistance to fatigue.

3.4.2 The requirements for assessment of fatigue damage shall be as set out in clause 6.9 of BS EN 1991-2:2003.
3.5 Horizontal loads from rail traffic

3.5.1 All elements of bridges shall be designed for the lateral loads applied to the track by trains (nosing). The loading requirements shall be as set out in clause 6.5.2 of BS EN 1991-2:2003.

3.5.2 For bridges where the track is curved over the whole or part of the length of the bridge, bridges shall be designed to resist the applied centrifugal force, taking account of track cant. The applied centrifugal force shall be determined in accordance with the requirements of clause 6.5.1 of BS EN 1991-2:2003.

3.5.3 Actions due to traction and braking shall be determined in accordance with the requirements of clause 6.5.3 of BS EN 1991-2:2003 and clause NA.2.45 of the National Annex to BS EN 1991-2:2003.

3.5.4 Bridge abutments and similar retaining elements (for example wing walls and retaining walls) are subject to additional horizontal loading, due to the weight of trains distributed vertically and horizontally through the backfill, adjacent to the structure (surcharge). Abutments and similar retaining elements shall be designed in accordance with the requirements of clause 6.3.6.4 of BS EN 1991-2:2003.

3.6 Design to resist derailment on the bridge

3.6.1 The requirements for determination of actions due to derailment of trains on a railway bridge shall be as set out in clause 6.7.1 of BS EN 1991-2:2003. Additional requirements for the design of deck plates and similar local elements are specified in clause NA.2.75 of the National Annex to BS EN 1991-2:2003.

3.6.2 For railway bridges, an effective means of containing a derailed vehicle on the bridge shall be provided taking account of the lower sector structure gauge defined in GC/RT5212 ‘Requirements for Defining and Maintaining Clearances’. The design shall consider measures to mitigate the consequences of derailment for structural elements situated above the level of the rails.
Part 4

Design of altered and temporary bridges

4.1  Altered bridges

4.1.1  For existing bridges, where it is proposed to alter the structure of the bridge, the
loading specified shall be sufficient for the intended rail traffic using the route.

4.1.2  It is permissible to base the design loading on the load model for deriving route
availability numbers set out in GE/RT8006.

4.2  Temporary bridges

4.2.1  Temporary bridges shall take into account:

   a)  The rail traffic that will be permitted to use the bridge

   b)  The intended life of the bridge

   c)  Any site-specific hazards

   d)  Any control measures required to prevent overloading of the bridge.

4.2.2  It is permissible to base the design loading on the load model for deriving route
availability numbers set out in GE/RT8006.
Part 5  Design of other structures for rail traffic loading

5.1  Structures (other than bridges) supporting the railway

5.1.1  Vertical loads from railway traffic

5.1.1.1  Structures (other than bridges) subject to vertical loading from rail traffic, shall be designed for the worst effects from the load models defined for bridges in 2.1.2 or 3.1.2 of this document.

5.1.1.2  Other structures (for example tunnel inverts, buried structures and embankments) shall be designed in accordance with BS 5400-2:2006 or BS EN 1991-2:2003, and account shall be taken of the distribution of load below the track and the dispersal of load with depth.

5.1.2  Horizontal loads from railway traffic

5.1.2.1  Structures (other than bridges) subject to horizontal loading from rail traffic shall be designed for the worst effects from the load models defined for bridges in 2.5 or 3.5 of this document.

5.1.2.2  Other structures (for example tunnel inverts, buried structures and embankments) shall be designed in accordance with BS 5400-2:2006 or BS EN 1991-2:2003, and account shall be taken of the distribution of load along the track and the dispersal of load with depth.

5.1.3  Surcharge from railway traffic

5.1.3.1  Structures (other than bridges) supporting the railway (for example retaining walls) are subject to additional horizontal loading, due to the weight of trains distributed vertically and horizontally through the backfill, adjacent to the structure (surcharge).

5.1.3.2  Structures designed to BS 5400-2:2006 shall be designed in accordance with the requirements of clause 5.8.2.1 c) of that document. This loading may be assumed to include an allowance for dynamic effects.

5.1.3.3  Structures designed to BS EN 1991-2:2003 shall be designed in accordance with the requirements of clause 6.3.6.4 of that document.
Part 6  Design of structures for aerodynamic actions

6.1  Structures over or adjacent to the railway

6.1.1  Structures subject to the aerodynamic effects of passing trains

6.1.1.1  Structures susceptible to the aerodynamic effects of passing trains shall be
designed to resist the resultant aerodynamic forces. Structures that are
particularly sensitive to transient pressure fluctuations could require a special
study to consider the dynamic performance of structures subject to the
aerodynamic effects of passing trains.

6.1.1.2  For structures designed to BS 5400-2:2006, the requirements shall be as set out
in clause 8.2.11 of that document.

6.1.1.3  The requirements for structures designed to BS EN 1991-2:2003 shall be as set out
in section 6.6.1 of that document. Clause NA.2.74 of the National Annex to
BS EN 1991-2:2003 permits the values of aerodynamic actions to be determined
on an individual project basis. Advice on alternative design pressures for
footbridges and platform canopies is contained in the National Application
Part 7  Design of structures to resist derailment actions

7.1 Structures over, or adjacent to, the railway subject to the effects of collision loading from derailment

7.1.1 General
7.1.1.1 The collision loading requirements of Part 7 applies to the supports of bridges, the supports of similar structures used by people (for example buildings, footbridges), and to structures carrying hazardous materials (for example gas) over or adjacent to the railway.

7.1.2 Design to BS 5400-2:2006
7.1.2.1 Structures designed to BS 5400-2:2006 with supports within the hazard zones shall be designed to resist the effects of collision loading. The hazard zones shall be assumed to extend for a width of 4.5 m from the cess rail and to include anywhere between the tracks.

7.1.2.2 Where individual columns are located within a hazard zone, the design of the span over the railway shall incorporate sufficient continuity such that the loss of any one column will not lead to the collapse of the remainder of the structure under the permanent load, the primary traffic (road or rail) load and any footway / cycleway live loads, in accordance with combination 1 of Table 1 in BS 5400-2:2006. The ultimate limit state partial load factors shall be as set out in Table 1, except that the partial factor for live loading ($\gamma_L$) shall be taken as 1.0.

7.1.2.3 Additionally, all piers or columns within a hazard zone shall be designed to withstand (without collapse) a single horizontal design force of 2000 kN acting at a height of 1.2 m above the adjacent ground level, and a single horizontal design force of 500 kN acting at a height of 3 m above the adjacent ground level. The two forces shall act in any direction but need not be considered to act simultaneously. The ultimate limit state partial load factor for the horizontal design force ($\gamma_L$) shall be taken as 1.0.

7.1.2.4 The requirements in 7.1.2.3 of this document are a minimum. Additional recommendations for design requirements are contained in UIC Leaflet 777-2R.

7.1.3.1 For structures designed to BS EN 1991-2:2003, the design of supports and superstructures over or adjacent to the railway shall be in accordance with the requirements of clause 6.7.2 of that document.

7.1.3.2 Clause 6.7.2 of BS EN 1991-2:2003 requires design for collision with structures over or adjacent to the track to be undertaken in accordance with BS EN 1991-1-7:2006 and, where appropriate, its National Annex.
Part 8  Application of this document

8.1  Application - infrastructure managers

8.1.1  Scope
8.1.1.1 The requirements of this document apply to new, reconstructed, altered and temporary structures. Section 1.2.4 sets out the details of the types of structure to which this document applies.

8.1.2  Exclusions from scope
8.1.2.1 There are no exclusions from the scope specified in section 8.1.1 for infrastructure managers.

8.1.3  General compliance date for infrastructure managers
8.1.3.1 This Railway Group Standard comes into force and is to be complied with from 07 February 2009.

8.1.3.2 After the compliance date or the date by which compliance is achieved if earlier, infrastructure managers are to maintain compliance with the requirements set out in this Railway Group Standard. Where it is considered not reasonably practicable to comply with the requirements, authorisation not to comply should be sought in accordance with the Railway Group Standards Code.

8.2  Application - railway undertakings
8.2.1 There are no requirements applicable to railway undertakings.

8.3  Health and safety responsibilities
8.3.1 Users of documents published by RSSB are reminded of the need to consider their own responsibilities to ensure health and safety at work and their own duties under health and safety legislation. RSSB does not warrant that compliance with all or any documents published by RSSB is sufficient in itself to ensure safe systems of work or operation or to satisfy such responsibilities or duties.
**Rail Traffic Loading Requirements for the Design of Railway Structures**

**Definitions**

**Abutment**
An end support of a bridge whose function is to support the weight of the bridge, the loads exerted by railway vehicles and the weight of the earth embankment behind the support.

**Accidental action**
An action, usually of short duration but of significant magnitude, that is unlikely to occur on a given structure during the design working life.

For the purpose of this document the term is generally taken to refer to the effects of derailment of a railway vehicle on, below or adjacent to a railway structure.

**Aerodynamic action**
An action that results from the force exerted on railway structures over or adjacent to the railway due to the transient pressures generated by passing railway vehicles.

**Alteration [for example, of a bridge or other railway structure]**
For the purpose of this document, the substantial widening, lengthening or rebuilding of all or part of an existing bridge or other railway structure, which provides a reasonable opportunity to bring the items concerned into conformity with the requirements of this document.

**Bridge**
A structure of one or more spans greater than or equal to 1800 mm, whose prime purpose is usually to carry traffic or services over an obstruction or gap.

**Buried structure**
A structure at a depth which is significant in relation to its span and for which the application of load can rely on the arching action of the soil above.

**Culvert**
A structure with a span or diameter greater than 450 mm and less than 1800 mm, whose prime purpose is usually, but not exclusively, to permit water or services to pass under a railway or road. The term excludes effluent pipelines passing under a railway or road.

**Deformation**
All deflection and rotational movements in a railway structure due to the effects of railway traffic.

**Dynamic performance**
The dynamic response of a railway structure, in particular the likelihood that excessive dynamic effects, including resonance, will occur under rail traffic. Dynamic effects are established from determination of the deformation, acceleration and natural frequency limits for a particular structure.

**Dynamically sensitive structures**
For the purpose of this document, railway structures for which the dynamic performance may be unacceptable at vehicle speeds less than 125 mph (200 km/h).

**Embankment**
An earthwork that allows railway lines or access roads to pass over low lying ground, or ground liable to flood, at an acceptable level and gradient.
Fatigue
Failure of structural elements and connections subject to the effects of repeated rail traffic loading.

Horizontal load
The resultant force exerted on a railway structure in the direction of travel (longitudinal) or normal to the direction of travel (transverse) as a consequence of the operating characteristics of the moving railway vehicle and its interaction with the track.

New bridge
For the purpose of this document the term ‘new bridge’ includes total superstructure replacement.

Railway structure
A structure below, over or adjacent to the railway which is subject to loading from rail traffic.

For the purpose of this document, the term includes underline bridges, the supports of overline bridges, lineside structures, tunnel inverts, buried structures and embankments.

Retaining wall
For the purpose of this document, an independent wall whose function is to support the weight of the retained earth that carries rail traffic surcharge loading.

Surcharge load
The additional horizontal load, due to the distribution of the weight of railway vehicles through the backfill adjacent to bridge abutments and similar earth retaining structures (for example wing walls and retaining walls).

Tunnel
An underground enclosed structure provided to allow the railway to pass under higher land, buildings or water, significantly longer than it is wide.

Tunnel invert
For the purpose of this document, the surface of the tunnel structure that supports rail traffic. The term excludes any non-ballasted (slab) track structures supported by the invert.

Vertical load
The resultant force exerted on a railway structure in the vertical direction as a consequence of the weight of a railway vehicle, the operating characteristics of the moving railway vehicle, and its interaction with the track.

Wing wall
A wall that complements an abutment and whose function is to support the weight of, that part of the earth embankment behind the bridge that slopes away from the sides of the track, and rail traffic, where it can affect the wall.
Rail Traffic Loading Requirements for the Design of Railway Structures

References

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by RSSB. This information is also available from www.rgsonline.co.uk.

Documents referenced in the text

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